# Instruction Manual

ACCESSORY

MODEL A4200

FLUKE®

JOHN FLUKE mfg. co., inc.
SEATTLE, WASHINGTON

ACCESSORY

MODEL A4200

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Accessory

# Model A4200

## 6-1. INTRODUCTION

6-2. The Model A4200 Manual Control Unit (MCU) with attaching interface cable and connectors is a manually operated program source for the 4200A series power sources. Figure 6-1 shows the MCU connected to a typical FLUKE power source. The purpose of the MCU is to permit an operator to fully exercise the programmable functions of any 4200A series power source, primarily for manual programming, calibration and adjustment, or for trouble-shooting. Secondly, a synchronized oscilloscope display of a 4200A series power source output may be established and controlled with an MCU.

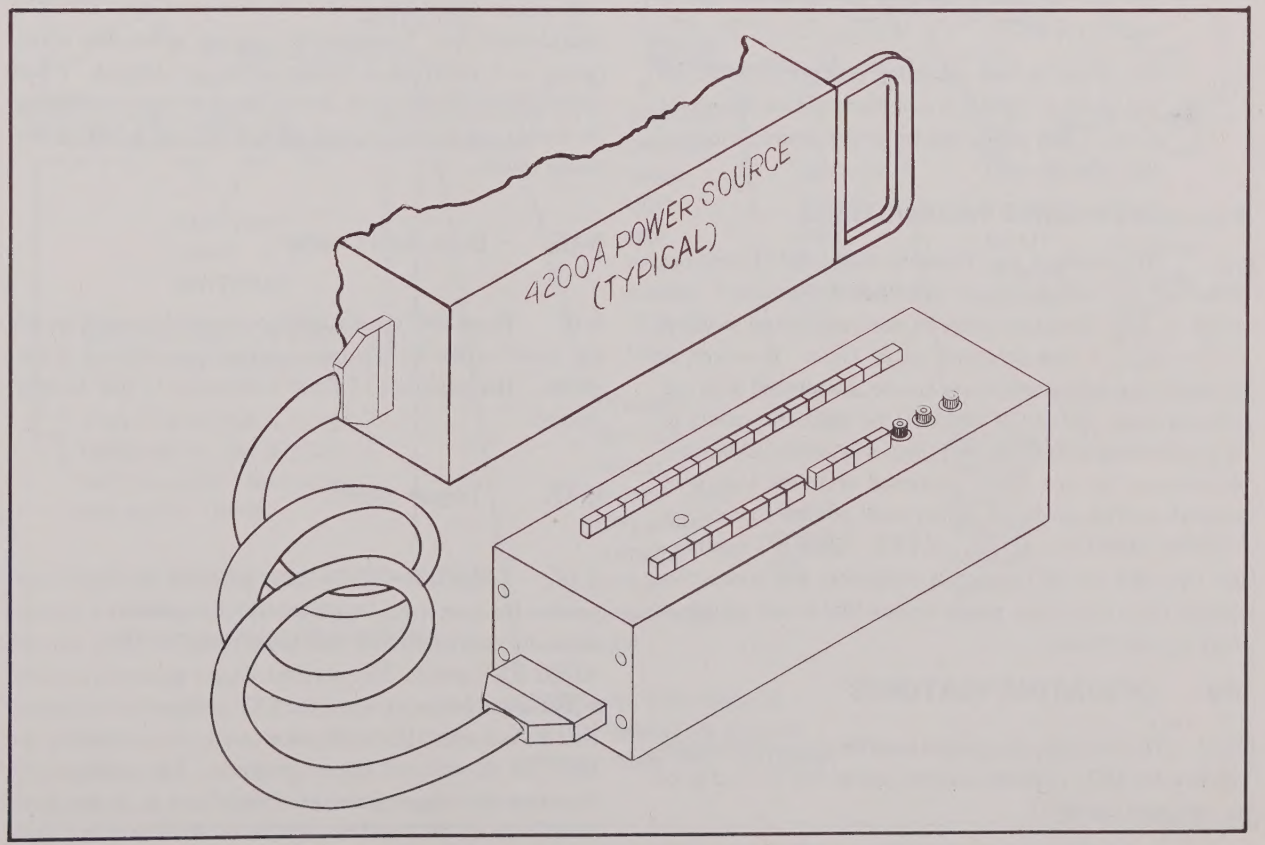



Figure 6-1. MODEL A4200 MANUAL CONTROL UNIT CONNECTED TO TYPICAL POWER SOURCE.

## 6-3. SPECIFICATIONS

6-4. There are no specifications for the Model A4200 MCU.

## 6-5. INSTALLATION

6-6. The MCU is supplied with an interface cable and connectors designed to fit any of the 4200A series power sources. The operating voltages for the MCU are supplied from the associated power source through the interface cable. The interface cable also supplies the power source with all programming inputs initiated by the MCU. Connection of the MCU to the power source via the interface cable is done as follows:

CAUTION!

**The Model A4200 MCU is NOT compatible with the –09 option.**

a. Turn off the power source and disconnect the programming connector from the rear panel of the power source.

b. Connect the interface cable connectors to both the programming connector on the power source and on the MCU.

c. Select the desired operating configuration on the top panel of the MCU and then turn on the power source. The power source is now ready for operation with the MCU.

## 6-7. OPERATING INSTRUCTIONS

6-8. The location and function of the MCU controls, indicators and connectors are described in Figure 6-2. The active or high level logic state of the pushbutton switches on the MCU is the depressed or *in* state. However, in the event the associated power source is equipped with the inverted logic option (08 Option), the logic level states of all pushbuttons defined below is high when the pushbuttons are extended or *out*. When depressed or *in*, the logic level state is low. This condition applies to all pushbuttons except STROBE, MANUAL, AUTO, and EXT. Figure 6-2 functionally describes the MCU controls, indicators, and connectors related to an associated power source that is not equipped with an –08 Option.

## 6-9. OPERATING FEATURES

6-10. The following paragraphs describe operating features relating the MCU to power sources and should be read prior to operating the MCU.

### 6-11. Isolated Control Logic (–01 Option)

6-12. The MCU provides the digital input programming, including the STROBE pulse, necessary to test and control an associated 4200A power source equipped with an isolated control logic option (–01 Option) or with an inverted isolated control logic option (–08 Option). When using either option, a STROBE pulse is required to start the digital-to-analog conversion process after a valid digital input program is entered. In MANUAL mode, the STROBE pulse is generated by manual depression of the STROBE pushbutton. In AUTO/EXTERNAL REFERENCE mode, the STROBE pulse is generated automatically following a 1.5μs delay that terminates the last programmed bit. The STROBE pulse is 0.5μ sec wide with a minimum width of 500 ns. A negative slope (+5V to 0 transition) is required.

### 6-13. Direct Coupled Control Logic (–04 Option)

6-14. Power sources using the direct coupled control logic option do not require use of the STROBE pulse. When used in the AUTO mode the performance is limited by the timing format of the STROBE pulse. Ideally, the STROBE pulse should precede the input data change and last until the input data is settled. The STROBE pulse, however, occurs about 1.5μs after the change of input data and lasts about 0.5μs. Consequently, voltage spikes may occur (going to 0 volts) when voltage levels are stepped. These spikes may be observed on an oscilloscope when monitoring the power source output and do not indicate a fault in the power source.

### 6-15. Coax Jack Cluster

6-16 Three BNC coaxial cable connectors located on the top panel of the MCU provide connections for test instruments. The common of these connectors is tied to logic ground.

### 6-17. Trigger Input

6-18. TRIGGER INPUT jack provides an input connection for an external trigger generator to produce a remote, manually controlled STROBE pulse when the MCU is in the AUTO EXT mode. The external trigger generator replaces a 10kHz multivibrator when the EXT pushbutton is depressed. An external 51Ω termination resistor is provided in the MCU for the external trigger generator. For optimum performance the trigger generator should have an output pulse impedance of 50Ω and be capable of producing the waveform shown in Figure 6-3.

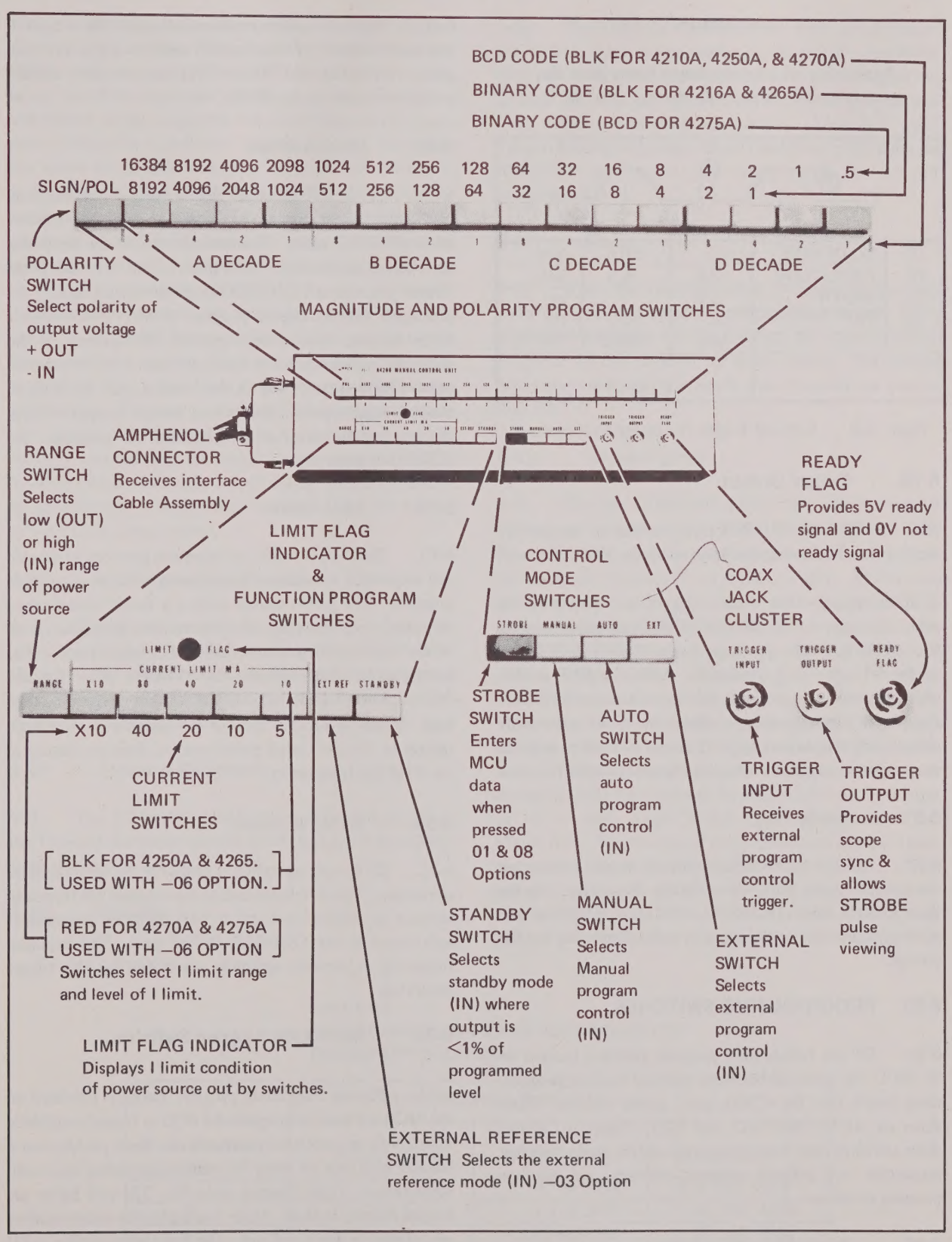
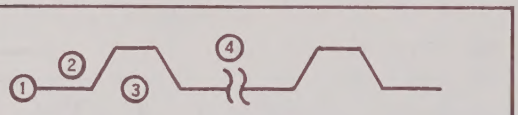

BCD CODE (BLK FOR 4210A, 4250A, & 4270A)
BINARY CODE (BLK FOR 4216A & 4265A)
BINARY CODE (BCD FOR 4275A)
16384 8192 4096 2098 1024 512 256 128 64 32 16 8 4 2 1 .5
SIGN/POL 8192 4096 2048 1024 512 256 128 64 32 16 8 4 2 1
A DECADE
B DECADE
C DECADE
D DECADE
POLARITY SWITCH
Select polarity of output voltage
+ OUT
- IN
MAGNITUDE AND POLARITY PROGRAM SWITCHES
AMPHENOL CONNECTOR
Receives interface Cable Assembly
RANGE SWITCH
Selects low (OUT) or high (IN) range of power source
LIMIT FLAG INDICATOR & FUNCTION PROGRAM SWITCHES
CONTROL MODE SWITCHES
STROBE MANUAL AUTO EXT
READY FLAG
Provides 5V ready signal and 0V not ready signal
COAX JACK CLUSTER
TRIGGER INPUT
TRIGGER OUTPUT
READY FLAG
LIMIT FLAG
CURRENT LIMIT MA
RANGE X10 80 40 20 10 EXT REF STANDBY
X10 40 20 10 5
CURRENT LIMIT SWITCHES
BLK FOR 4250A & 4265.
USED WITH –06 OPTION.
RED FOR 4270A & 4275A
USED WITH –06 OPTION
Switches select I limit range and level of I limit.
LIMIT FLAG INDICATOR
Displays I limit condition of power source out by switches.
STROBE SWITCH
Enters MCU data when pressed
01 & 08 Options
AUTO SWITCH
Selects auto program control (IN)
STANDBY SWITCH
Selects standby mode (IN) where output is <1% of programmed level
MANUAL SWITCH
Selects Manual program control (IN)
EXTERNAL SWITCH
Selects external program control (IN)
TRIGGER INPUT
Receives external program control trigger.
TRIGGER OUTPUT
Provides scope sync & allows STROBE pulse viewing
EXTERNAL REFERENCE SWITCH Selects the external reference mode (IN) –03 Option

Figure 6-2 CONNECTORS, CONTROLS, AND INDICATORS

**CAUTION**

**Application of trigger voltages higher than the recommended value will damage the MCU.**




| | | | | |
|---|---|---|---|---|
| ① | DC OFFSET | – | ±0.4 | Vdc |
| ② | AMPLITUDE | +2.8 | +5.5 | Vdc |
| ③ | WIDTH | 0.5 | – | μs |
| ④ | PRF | DC | 10K | Hz |
| | | MIN | MAX | UNITS |
| | | LIMITS | | |

Figure 6-3. External Trigger Generator Requirements

### 6-19. Trigger Output

6-20. TRIGGER OUTPUT jack provides an output connection for monitoring the inverse of the MCU generated

STROBE pulse. The output trigger is a positive-going pulse that occurs each time a STROBE pulse is generated. It is useful in synching a scope to the MANUAL-STROBE mode. However, when using the AUTO or EXT modes, which generate an automatic internal or external STROBE, the output trigger provides a valid scope sync for the ready or not ready flag output only. It cannot be used to monitor the power source output voltage in the AUTO or EXT modes.

### 6-21. Ready Flag

6-22. READY FLAG jack provides an output connection for monitoring the ready or not ready flag voltage. In the three control modes (MANUAL, AUTO, or EXT) the output trigger provides a valid scope sync for displaying the flag voltage.

## 6-23. PROGRAMMING SWITCHES

6-24. Of the twenty-nine program switches located on the MCU top panel, all but three are used to enter programming inputs into the 4200A series power sources. These three are AUTO, MANUAL, and EXT. Figure 6-2 divides these switches into three groups of control mode switches, magnitude and polarity program switches, and function program switches.

### 6-25. Control Mode Switches

6-26. The four control mode switches provide manual or automatic control of the manually selected input data program. MANUAL, AUTO, or EXT are the three control modes selectable on the MCU.

### 6-27. Manual Mode

6-28. The MANUAL mode allows manual manipulation of the input programming data as well as manual generation of the STROBE pulse. This mode is selected by depressing the Manual pushbutton. Each push of the STROBE pushbutton generates a 0.5μs STROBE pulse which transfers the previously selected manual program to the internal registers of the isolated control logic option (–01 Option). In the event the power source is equipped with a direct coupled control logic option (–04 Option) rather than the isolated control logic option, the power source output voltage changes as the program pushbuttons are pressed. No STROBE is necessary.

### 6-29. Auto Mode

6-30. The AUTO mode of operation provides automatic and sequential scanning of a previously selected magnitude program. The power source output is thusly stair-stepped or pulsed in a manually selected pattern, the sequence of which is governed by an internal 10kHz multivibrator. The multivibrator also initiates the STROBE pulse for the isolated control logic option. If a direct coupled control logic option is used in lieu of the isolated control logic option in the associated power source, then the timing of the STROBE is incorrect.

### 6-31. External Mode

6-32. EXT mode operation is similar to the auto mode of operation. The difference is that the internal 10kHz multivibrator is switched out and an external pulse generator is substituted at the TRIGGER INPUT jack. The sequence frequency is thereby remotely controlled by the trigger generator.

### 6-33. Magnitude Program Switches

6-34. Sixteen magnitude program switches provided on the MCU are used to program the BCD or binary magnitude inputs into an associated power source. Each pushbutton is labeled with one or more bit values depending upon unit serialization. Units bearing serial No. 224 and below are labeled entirely in black. Units bearing higher serial numbers are labeled in black and red. The red coding applies to (1) the binary magnitude used to program the 4275A power

source, and (2) to the current magnitude used to program the current limit option (when installed) in the 4270A and 4275A power sources. The black coding applies to both binary and BCD magnitude power sources with the location and format of the magnitude bits identifying related power source effectivity as follows: The black binary magnitude bits above the pushbuttons apply to the 4216A and 4265A power sources. The black BCD magnitude bits below the pushbuttons apply to the 4210A, 4250A, and 4270A power sources. In MANUAL mode the magnitude inputs are programmed directly by depressing a single or combination of magnitude pushbuttons. In AUTO mode an internal binary counter controls the manually selected magnitude inputs in a four-bit binary pattern. Each output of the binary counter is parallel connected to the four corresponding BCD or binary magnitude programming switches shown in Table 6-1. The power source input program is sequenced in a pattern that is determined by the selected magnitude program switches and the binary counter outputs. Figure 6-4 shows the power source output voltage patterns available by programming a single decade in the 4210A, the 4250A, or the 4270A power source.

## 6-35. Polarity or Sign/Polarity

6-36. The polarity program for the power sources is controlled by the program switch marked POL or SIGN/POL. Depressing this switch commands the negative programmed output voltage. The non-depressed or *out* position commands the positive programmed output voltage.

## 6-37. External Reference

6-38. The EXT REF switch, when depressed, programs the External Reference Option (–03 Option) of the 4200A series power sources.

## 6-39. Standby

6-40. The STANDBY switch, when depressed, programs the 4200A series power sources to the standby condition. This condition permits a single bit on a given control line to clear the output to about 1 percent of the programmed level without disturbing the previous command word. Upon returning to the operational condition by releasing the STANDBY pushbutton, the output reverts to the pre-programmed level.

## 6-41. Range

6-42. When the RANGE switch is depressed, the high range of the associated power source is programmed. When not depressed and in the *out* position, the RANGE switch programs the low range of the power source. The low and high ranges of the 4200A series power sources are given in Table 6-2.

## 6-43. Current Limit

6-44. The five CURRENT LIMIT MA switches labeled in black or in black and red numbers, depending upon serial No. effectivity, program the Programmable Current Limit Option (–06 Option) in the 4250A, 4265A, 4270A, and 4275A power sources. The black numbered pushbuttons are used with the 4250A and 4265A power sources and the red numbered pushbuttons are used with the 4270A and 4275A power sources. Pushbutton switches labeled in black enable selection of the desired current limit point in increments of 10mA low range or 100mA high range (X10) for the 4250A and 4265A power sources (Table 6-3). The red labeled pushbutton switches enable selection of the desired current limit point in increments of 5 mA low range or 50 mA high range (X10) for the 4270A and 4275A (Table 6-4). When none of the pushbuttons are depressed, the current limit is 10 percent of selected range; i.e., 10 mA and 100 mA for the 4250A and 4265A; 5 mA and 50 mA for the 4270A and 4275A. The 4210A and 4216A power sources do not utilize the programmable current limit

TABLE 6-1
PROGRAMMING SWITCHES CONTROLLED BY THE BINARY COUNTER.

| Binary Counter outputs | PROGRAMMING SWITCHES | | |
|---|---|---|---|
| | 4210A-4250A | 4216A-4265A | 4270A-4275A |
| 1 | 1,1,1,1 | 4, 64,1024 | .5, 8, 128, 2048 |
| 2 | 2,2,2,2 | 8,128,2048 | 1, 16, 256, 4096 |
| 4 | 4,4,4,4 | 1,16,256,4096 | 2, 32, 512, 8192 |
| 8 | 8,8,8,8 | 2,32,512,8192 | 4, 64, 1024, 16384 |

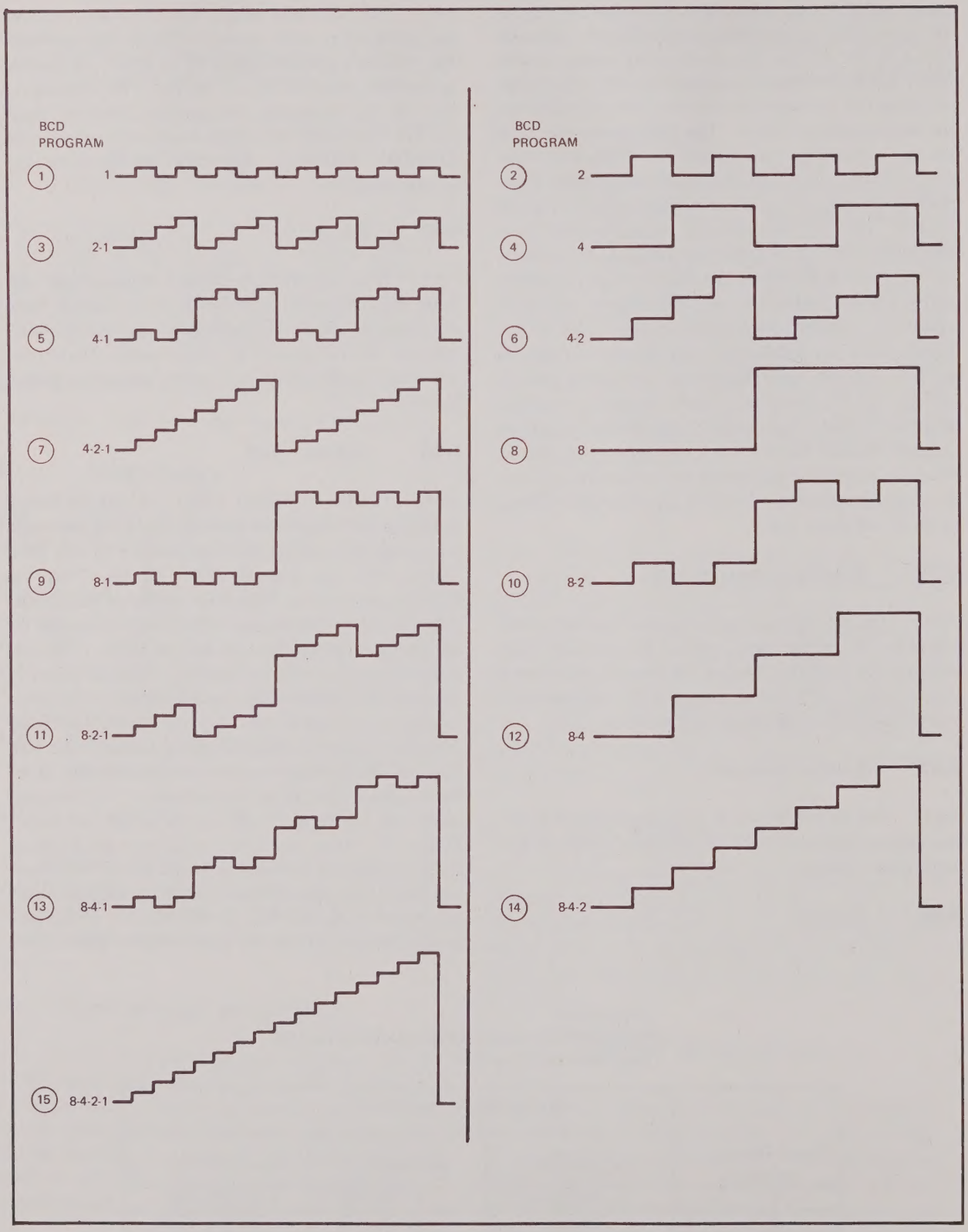



Figure 6-4. VOLTAGE PATTERNS OBTAINABLE BY DECADE PROGRAMMING IN THE AUTO MODE (4210A, 4250A, AND 4270A)

TABLE 6-2. 4200A SERIES INSTRUMENT RANGES

| RANGE | | INSTRUMENT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| PUSH-BUTTON | STATE | 4210A 4216A | 4250A | | 50 VOLT RANGE INDICATOR | 4265A | 65 VOLT RANGE INDICATOR | 4270A | 110 VOLT RANGE INDICATOR | 4275A | 110 VOLT RANGE INDICATOR |
| OUT | LOW | 16V | BCD 10V | BINARY 16V | OFF | 16V | OFF | 10V | OFF | 32V | OFF |
| IN | HIGH | 16V | 65V | 65V | ON | 65V | ON | X10 | ON | X4 | ON |

TABLE 6-3. CURRENT LIMIT PROGRAMMING WITH –06 OPTION

| 4250A • 4265A CURRENT LIMIT MA PUSHBUTTON(S) DEPRESSED | RANGE (mA) | |
|---|---|---|
| | LOW | X10 |
| NONE | 10 | 100 |
| 10 | 10 | 100 |
| 20 | 20 | 200 |
| 20 • 10 | 30 | 300 |
| 40 | 40 | 400 |
| 40 • 10 | 50 | 500 |
| 40 • 20 | 60 | 600 |
| 40 • 20 • 10 | 70 | 700 |
| 80 | 80 | 800 |
| 80 • 10 | 90 | 900 |
| 80 • 20 | 100 | 1000 |
| INCREMENTAL CHANGE | 10 | 100 |
| • AND CURRENT LIMIT WITHOUT –06 OPTION IS 1200mA | | |

TABLE 6-4. CURRENT LIMIT PROGRAMMING WITH –06 OPTION

| 4270A • 4275A CURRENT LIMIT MA PUSHBUTTON(S) DEPRESSED | | RANGE (mA) | |
|---|---|---|---|
| RED | BLACK | LOW | X10 |
| NONE | NONE | 5 | 50 |
| 5 | 10 | 5 | 50 |
| 10 | 20 | 10 | 100 |
| 10 • 5 | 20 • 10 | 15 | 150 |
| 20 | 40 | 20 | 200 |
| 20 • 5 | 40 • 10 | 25 | 250 |
| 20 • 10 | 40 • 20 | 30 | 300 |
| 20 • 10 • 5 | 40 • 20 • 10 | 35 | 350 |
| 40 | 80 | 40 | 400 |
| 40 • 5 | 80 • 10 | 45 | 450 |
| 40 • 10 | 80 • 20 | 50 | 500 |
| INCREMENTAL CHANGE | | 5 | 50 |
| • AND CURRENT LIMIT WITHOUT –06 OPTION IS 600mA | | | |

option, but do have a basic current limit of 100 mA. The basic current limit of the 4250A and 4265A power sources when not using the current limit option is 1.2 amp and, similarly, for the 4270A and 4275A is 0.6 amp.

### 6-45. Front Panel Indicator

6-46. The indicator labeled LIMIT FLAG on the MCU top panel is illuminated when a current overload (sink or source) condition occurs in the associated power source.

## 6-47. THEORY OF OPERATION

### 6-48. General

6-49. The A4200 MCU contains manually controlled switching circuits, internal, fixed-frequency triggered switching circuits, and provisions for externally controlled, variable frequency triggered switching circuits that provide the logic signals to control an associated programmable power source. These switching circuits permit manual control of the power source output voltage as well as an automatically triggered, repetitive and manually variable program for controlling the power source output voltage. The MCU is also provided with input-output circuits that, with the aid of a supplemental scope, permit the visual presentation of the ready or not ready status of the power source, the trigger output signal, and a means of connecting an external trigger.

### 6-50. Block Diagram Analysis

6-51. A simplified block diagram of the MCU is shown in Figure 6-5. The primary function of the MCU is to pro-

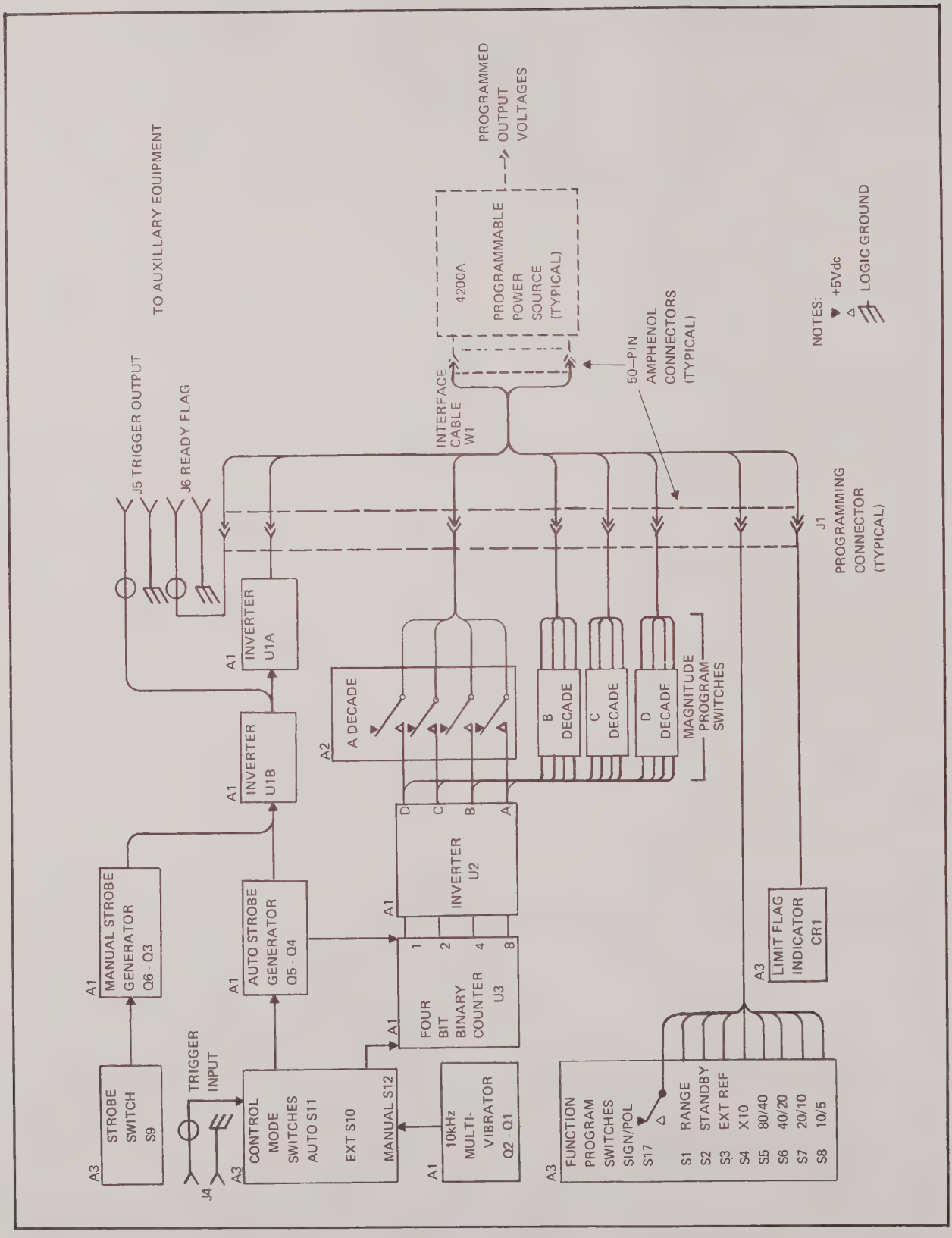



FIGURE 6-5. A4200 MANUAL CONTROL UNIT BLOCK DIAGRAM

vide manual control of the programming inputs into the 4200A series power sources. Switching by the following groupings of switches accomplishes this purpose: control groupings of switches accomplishes this purpose: control mode switches, magnitude program switches, and function program switches. The secondary function of the MCU is to provide an automatic mode of operation that applies a manually selected and manually variable magnitude program repetitively at a fixed or variable rate to a power source. This is accomplished by the following: a 10kHz oscillator, the control mode switches, and a 4-bit binary counter. The manual and auto strobe generators provide control of the strobing pulse for both the manual and automatic modes of operation.

6-52. With manual mode selected by A3 control mode switch S12, the four-bit counter is supplied with a logic 0 (low). This sets all four outputs of the counter to a logic 1 (high). Inverter U2 reverses the logic 1 on all four counter output lines to a logic 0, and then applies them in parallel through all closed magnitude program switches to the programmable power source via the interface cable and programming connectors. However, before the power source can act on the logic levels present on each of the 16 data lines, a logic level 0 manual strobe pulse must be entered. This is accomplished by manual depression of the strobe pushbutton switch S9, applying a logic 1 to the manual strobe generator Q6-Q3, which, in turn, supplies a logic 0 to inverter U1B. The dual inversion of inverters U1B and U1A then supplies the programmable power source with a logic 0 and the programmed output voltage appears at the output of the power source when the power source is equipped with the isolated control logic option.

6-53. With auto mode selected by A3 control mode switch S11, the previously selected manual mode switch is disconnected through interlock action. This removes the logic 0 applied to the set lines of binary counter U3. Simultaneously, the 10kHz multivibrator output is applied to two places: to the clock input of binary counter U3 and to the input of the auto strobe generator, Q5-Q4. The 10kHz multivibrator input to the binary counter U3 clocks it low initially and triggers the repetitive waveform pattern shown in Figure 6-6. The multivibrator input to auto strobe generator Q5-Q4 produces a 10kHz strobe pulse at its output, approximately half a microsecond wide, that is negative going, descending from +5 to OVdc. The pulse is inverted once through inverter U1B, to be used as a trigger output pulse at J5, and is inverted a second time through inverter U1A to be applied to the programmable power source via the interface cable W1 and programming connectors. The sequential output of the 10kHz driven binary counter is applied to the power source through any closed magnitude program switch in each decade following inversion through inverter U2.

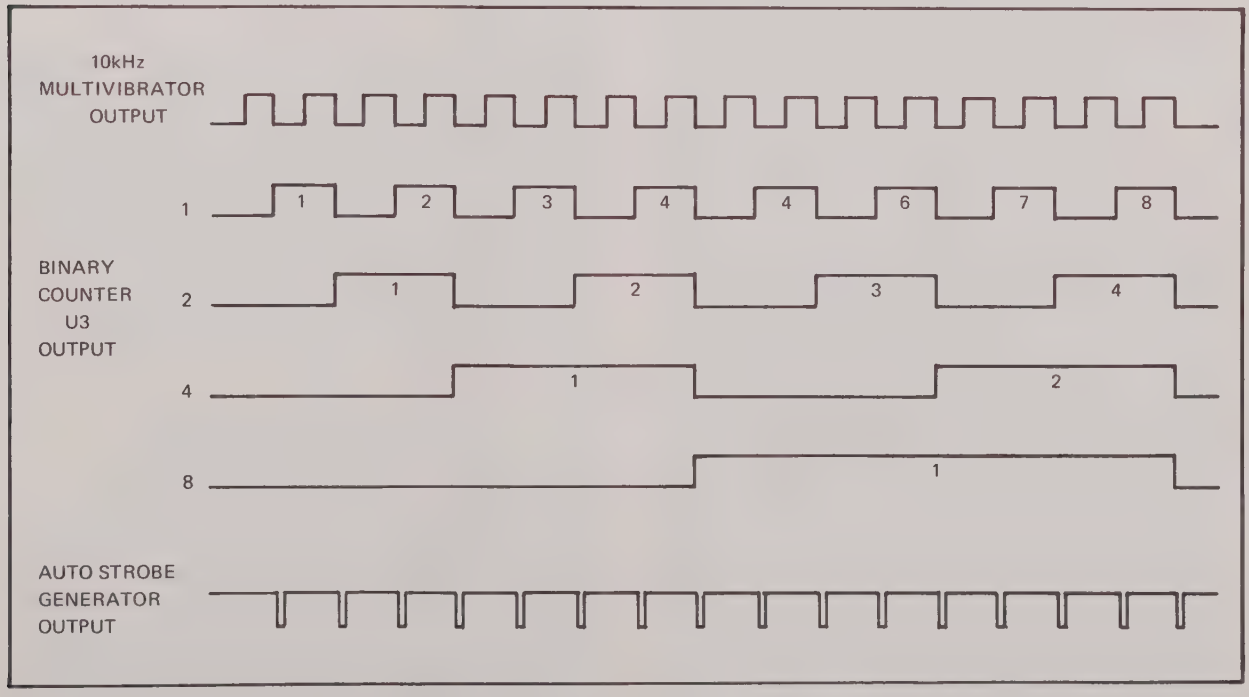



FIGURE 6-6. MODEL A4200 MCU TIMING DIAGRAM

6-54. With external mode selected by the A3 control mode switch, S10, the previously selected auto mode switch is disconnected through interlock action. This removes the 10kHz multivibrator output from the input to the binary counter and from the input to the auto strobe generator. Switched into these two input circuits is trigger input jack J4. Hence, use of an externally controllable trigger generator is possible, providing the parameters are generally as follows: output pulse frequency of 10kHz, 0.5μs pulse width, and having an output pulse impedance of about 50 ohms. The external trigger generator substitutes for the internal 10kHz multivibrator in the external mode, and circuit activity is essentially the same as discussed in auto mode.

6-55. The A3 function program switches provide a logic level low signal on the appropriate line to the connected power source when a given function switch is depressed. The SIGN/POL switch, S17, is shown as an example typical of these switches.

6-56. The indicator light LIMIT FLAG on the MCU top panel is essentially a duplication of the I LIMIT indicator on the front panel of a 4200A series power source. Hence, these two indicators can be expected to illuminate together when a specified current limit point is reached.

## 6-57. Circuit Description

6-58. The following paragraphs briefly describe the circuitry in the MCU. Each description, unless otherwise noted, is referenced to the schematic diagram A4200-1000 located at the end of this section.

6-59. CONTROL MODE SWITCHES. The control mode switches consist of three single pole, double-throw switches on the A3 Function Assembly, S10 through S12. These switches are the ganged, interlock, pushbutton type and only one switch at a time can be closed and latched. Switch S12, the MANUAL mode switch, when depressed and latched, applies a logic low (0 volts) to the four set input lines of the four-bit binary counter U3, pins 3,5,10, and 12. This forces the counter outputs on pins 4,6,9, and 11 to a logic high (5 volts). When the AUTO mode switch S11 is depressed and latched, the MANUAL mode switch is interlock released to its non-depressed state. This applies 5 volts to the binary counter previously held low by the latched, but now released MANUAL mode switch, and permits the counter to be advanced by the 10kHz multivibrator input at pin 1 of U3. The 10kHz MV output, supplied to the counter through the closed contacts of switch S11, is also applied to the input of the auto strobe generator at pin 9 of U1D. When the EXT mode switch S10 is depressed and latched, the AUTO mode switch is released. This removes the 10kHz MV output from the input of the auto strobe generator and from the clock input of the binary counter. The closed EXT mode switch connects the TRIGGER INPUT jack J4 to the counter and strobe generator inputs. An external 50 ohm pulse generator can be used to replace the 10kHz MV pulse. A 51 ohm resistor R1, provides the input termination for the external generator.

6-60. MAGNITUDE PROGRAM SWITCHES

6-61. The magnitude program switches consist of sixteen single pole, double-throw, push-push switches on the A2 Program Assembly, S1 through S16. The arms of these switches are wired directly to pins 1 through 16 of the J1 programming connector. The normally closed contacts of these switches are bussed to the 5Vdc power input, pin 25 of the programming connector. Hence, in their normally closed condition, which is the non-depressed state, these switches apply 5Vdc to pins 1 through 16 of the programming connector.

6-62. The normally open contacts of the switches are bussed in fours to one switch each in each of four groups, as S1 to S5 to S9 to S13, as S2 to S6, to S10, to S14, etc. In one case, these switches can be considered to be bussed in four BCD groups as determined by the weighting assigned each switch; i.e., 8, 4, 2, and 1. Thus, in the four decades, all similar weighted switches are paralleled on their normally open contacts.

6-63. Binary counter U3 supplies 1-2-4-8 logic levels through inverting gates U2D through A to the 1-2-4-8 switch busses, respectively. The logic levels are dependent on the state of the binary counter. In manual mode, the outputs of U3 are forced high (5 volts). Therefore, the outputs of the inventory gates supply a low (0 volts) to the switch busses. However, in auto or external mode, the switch busses are switched between high and low in a binary sequence and at a frequency determined by the 10kHz multivibrator, or by an external frequency applied at the trigger input jack J4.

6-64. FOUR-BIT BINARY COUNTER

6-65. The four-bit binary counter U3 is an asynchronous negative-edge triggered counter. The outputs (1-2-4-8) of the counter are connected to the correspondingly weighted busses of the sixteen magnitude program switches through the inverting gates of U2. The outputs of the counter are low at zero and go high in binary sequence. The clock required to advance the counter is supplied through the control mode switches by the 10kHz multivibrator, or by an

external pulse generator connected to trigger input jack J4.

6-66. TEN KILOHERTZ MULTIVIBRATOR

6-67. The 10kHz multivibrator is a simple, dual transistor (Q1-Q2) multivibrator designed to free run at approximately 10kHz. The square wave output is used in the auto control mode to clock the binary counter and to trigger the auto strobe generator.

6-68. AUTO STROBE GENERATOR

6-69. The A1 auto strobe generator is composed of transistors Q4-Q5 and inverter amplifiers U1A through U1E, plus related circuit components. It is an active pulse shaping network that is used to supply a strobe pulse in the auto and external modes of MCU operation. The negative descent of each 10kHz pulse from the 10kHz MV triggers the auto strobe generator. Following an approximate delay of 1.5 microseconds, a strobe pulse of half a microsecond, approaching 0 volts from a 5 Vdc reference, is produced at the input of inverter amp U1B. The output of U1B produces a positive-going pulse that is applied as a trigger at trigger output jack J5. Inverter amp U1A returns the strobe pulse to its original excursion and presents it at pin 33 of the programming connector.

6-70. MANUAL STROBE GENERATOR

6-71. The A1 manual strobe generator is composed of transistors Q6 - Q3, A3 control mode switch S9 (STROBE), and related circuit components. The manual strobe pulse generator is built around a programmable unijunction transistor (PUT) Q6 which is effectively anode gated by the application of a positive voltage through the momentary closed contacts of the STROBE pushbutton switch S9. The firing of Q6 turns on gating transistor Q3, which effectively applies a logic 0 pulse at the input of inverter amp U1B. Pulse processing through the two inverters, U1B and U1A, is the same as described in the previous paragraph.

6-72. FUNCTION PROGRAM SWITCHES

6-73. The function program switches consist of nine spot push-push switches (with one exception - the momentary contact STROBE switch S9) on the A3 Function Assembly, S1 through S9. The arms of these switches are wired directly to their corresponding pins on the J1 programming connector. These switches are independent and are not controlled by any other switches or any other circuitry, with the exception of the 5 volt 1ns line which is paralleled to the normally closed contacts of switches S1 through S8. Switch S9 is the opposite configuration with the 5 volt bus line tied to the normally open momentary contact. Switches S1 through S8, when depressed, latch to logic 0.

6-74. READY FLAG

6-75. Ready flag connector J6, mounted on the MCU top panel, produces an output of 5Vdc to indicate that the related power source is ready to accept programming inputs, or produces a 0 volt output to indicate that the power source is not ready to accept programming inputs. This output jack is tied directly to the power source through the interface cable and programming connectors on Pin 37.

6-76. LIMIT FLAG

6-77. Limit flag indicator CR1, mounted on the MCU top panel, is a red-light emitting diode. It illuminates when forward biased by a logic 1 (logic ground) on its cathode. A logic 1 is applied to the cathode from the programmable power source via the interface cable and programming connectors on Pin 49 when an overload (overcurrent) condition exists in the power source.

## 6-78. MAINTENANCE

### 6-79. Introduction

6-80. The maintenance procedures given in the following paragraphs describe maintenance access, pushbutton replacement, LIMIT FLAG indicator replacement, and troubleshooting.

### 6-81. Maintenance Access

6-82. Remove six Phillips Head screws from sides of channel bottom. Remove four Phillips Head screws securing rubber feet to bottom of unit.

6-83. Withdraw V-shaped channel bottom from MCU. Test points 1 through 5 are now accessible at bottom of unit on the component side of the motherboard, connector PCB Assembly.

6-84. Remove two Phillips Head screws from rear, left side of unit.

6-85. Remove motherboard, Connector PCB Assembly from the unit with a gentle rocking and pulling motion to separate motherboard from the two other PCB's in the unit.

6-86. Disconnect coaxial jack cluster connectors at the underside of the Function Assembly PCB. These four connectors may be colored BLK, RED, BRN and ORN.

6-87. Disconnect leads to LIMIT FLAG light emitting diode - also on the same PCB. These two leads may be colored ORN and YEL.

6-88. Remove two Phillips Head screws from the right side of the unit and two remaining screws from the left side of the unit.

6-89. Remove the switch panel from the MCU top panel. Each of the individual pushbutton switches are accessible for individual continuity checks. The upper switch bank is mounted on the Program PCB Assembly and the lower switch bank is mounted on the Function PCB Assembly. Prior to further disassembly, note the relationship of the program PCB and function PCB to the end flanges of the MCU top panel. Viewed from the rear, with program PCB uppermost, the cluster of four P-nuts must be on the right flange.

6-90. Removal of two Phillips Head screws from each of the ends of the program and function PCB's permit removal of these two boards with attached pushbutton switch banks.

6-91. Assembly of the MCU is done in reverse order of disassembly with attention to the proper locating of the program and function PCB's on the switch panel as noted in step 6-89. Reversal of these two PCB's is possible, but will not permit final assembly of the top panel.

## 6-92. Switch Maintenance

6-93. The following eleven paragraphs describe the procedure to be followed when a defective switch is to be replaced in the MCU.

6-94. Remove the PCB assembly that contains the defective switch using the maintenance access procedures given in the previous paragraphs.

6-95. Since individual pushbutton switches are not replaceable, an entire switch set that contains the defective switch must be replaced as a unit.

6-96. Refer to the List of Replaceable Parts to determine the FLUKE part number for the switch set to be replaced and order the switch set in conformance with part ordering instructions.

6-97. Following receipt of the correct replacement switch set, determine that it is operating correctly and then remove the switch set containing the defective switch as follows:

a. Using a small soldering iron and a solder removing tool, unsolder all of the switch set mounting tabs from the circuit board pads and remove as much liquified solder as possible with the solder removing tool.

b. Prevent adherence of the cooling tabs to the pads by vibrating each tab in its pad with a pair of needlenose pliers or a similar tool.

c. After all tabs are unsoldered from the PCB pads, remove the entire switch set from the PCB and exercise care to remove the PCB spacers that are attached to the switch tabs. Make a layout sketch of the positions of the spacers on the switch set.

d. Remove the spacers from the defective switch set and install them, each one on the new switch set in accordance with the layout sketch made in the previous step. Press the spacers tightly against the switches, cleaning out any flowed solder that prevents full surface contact between the spacers, switches, and PCB.

e. Insert the new switch set into the PCB in the same orientation as the adjacent switch set, top side up.

f. Solder all tabs into the PCB pads and be careful to press each switch tightly against the PCB. The installed switch set must be aligned with the adjacent switch set and with the PCB evenly, or else the switch assembly will not fit through the slots on the top panel at final assembly.

g. Check that the newly installed switch set is operating correctly and install the PCB into the MCU as defined under maintenance access.

## 6-98. Limit Flag Indicator Replacement

6-99. The following eleven paragraphs describe the procedure to be followed when a defective indicator is to be replaced in the MCU.

6-100. Refer to the List of Replaceable Parts to determine the FLUKE part number for the indicator to be replaced and order it in conformance with the part ordering instructions.

6-101. Install replacement indicator in the MCU as follows:

a. Perform maintenance access procedures to the step that removes the motherboard connector PCB Assembly from the MCU.

b. Locate insulating sleeving that covers one of the wires leading into the rear of the defective indicator and slide it back along the wire until the amp connector it covers is fully exposed. Observe color coding of wires for later hook-up.

c. With a long pointed soldering tool, unsolder the amp connector uncovered in the previous step from an indicator lead. Repeat with the other indicator lead and clean both amp connectors internally of any residual solder.

d. Using a blunt instrument or rod of sufficient diameter to clear the inside of the indicator retaining cup, push the indicator out the retaining cup from the rear. Observe orientation upon removal for later installation of replacement.

e. Using the removed indicator as a guide for the new indicator, clip the correct lead at the base and the other two leads to the proper length.

f. Insert the indicator into the cup in the same exact orientation as observed during removal of the defective indicator.

g. Connect both amp connectors identically to the earlier observed hook-up and solder connectors to the indicator leads using minimal heat and solder.

h. Slide the insulating sleeving over the amp connector to insulate the bare indicator leads from each other.

i. Assemble the MCU in accordance with procedures given under maintenance access.

## 6-102. TROUBLESHOOTING

6-103. The troubleshooting of an improperly responding and defective power source, when under control of an MCU, is not covered in this section. Troubleshooting the power source is covered, however, in the basic instrument maintenance section of the manual, and may not include use of the MCU as a troubleshooting aid. On the other hand, the first indication that troubleshooting is necessary will be an improperly responding power source that is under control of an MCU. Consequently, the first step in using these troubleshooting procedures is to determine that the MCU is faulty and not the associated power source.

6-104. The MCU and power source are tied together for one of three purposes: (1) for manual control of the programming inputs to a valid power source, (2) for calibration and adjustment of an out-of-tolerance or repaired power source, and (3) for troubleshooting an improperly operating power source. In the first two cases when malfunctions are observed in the response of the power source to MCU programming inputs, other than obvious mechanical faults on the MCU, such as a stuck switch, a bent or misaligned programming connector, or a servered cable wire - all of which are readily identified and repaired - isolation of the fault to the MCU is accomplished by disconnecting the MCU at the power source programming connector and connecting another programming source, known to be good, to the power source. In the third case where an MCU is used to troubleshoot an improperly operating power source and the MCU becomes suspect, the MCU must be considered defective and checked separately. A troubleshooting procedural outline is given on the reverse side of the foldout page which faces the schematic diagram of the MCU.

6-105. Equipment required for troubleshooting the MCU is a multimeter, an oscilloscope, and a 7-inch insulated shorting jumper terminated with midget alligator clips. Additionally, a 5 volt dc power supply is required for troubleshooting the MCU when it is disconnected from the power source.

6-106. With the interface cable attached and locked to the J1 programming connector on the MCU, gain access to the motherboard A1 Connector Assembly and locate test points 1 through 5. See maintenance access procedures, paragraph 6-81. Proceed with troubleshooting procedures given on drawing No. A4200-1800.

## MODEL A4200

## TROUBLESHOOTING PROCEDURES

### Power Off Checks

1. Inspect MCU for improperly seated plug-in assemblies, loose or broken wires, damaged or burned components, or other obvious problems.

2. Check that switches are aligned and that no broken switch return springs are evident.

3. Check that connectors are properly attached to motherboard A1 Connector Assembly from coaxial jacks and from LIMIT FLAG indicator.

### Power on Checks

1. Apply 5 Vdc to MCU in either of two ways to determine that power input and distribution circuits are continuous. Either apply power by connecting interface cable connector to power source and turning on power switch, or by locating test points 4 (+) and 3 (-) and applying +5Vdc to these test points from the and applying +5Vdc to these test points from the 5Vdc power supply.

2. If MCU is connected to a power source as defined above, check for +5Vdc between test points 4 (+) and 3 (-). If MCU is connected to the 5Vdc power supply at test points 4 (+) and 3 (-), check for +5Vdc between pin 25 (+) and any pin of the group number 17 through 24 (-) on the unconnected interface cable connector.

3. Failure to measure the required voltage at the places specified above indicates a defective interface cable/connectors or a defective A1 motherboard A1 Connector PCB Assembly. Refer to the schematic diagram and localize the fault to either the interface cable/connectors or to the A1 PCB, as appropriate.

   10kHz MULTIVIBRATOR CHECK. Check the output of the 10kHz multivibrator by measuring between test points 1 (+) and 3 (-) either with a multimeter set to 2.5Vdc for full scale deflection, or, if a waveform inspection is desired, connect the input of the scope to these test points and observe the square wave output as shown in Figure 6-6. If neither voltage nor waveform is present, the multivibrator may be locked up. In this case, remove power from the MCU and reapply as a step function to initiate flip-flop action of the multivibrator. Check output again, and, if none is observed, the multivibrator circuit is defective.

   MANUAL SWITCH, FOUR-BIT BINARY COUNTER, AND GATED INVERTER U2. Locate pins 9 through 12 on the rear of the interface cable connector attached to the A1 motherboard. Select one of the four pins for +5Vdc full scale deflection measurement on the meter. Use test point 3 (-) for ground reference. Depress and latch the C decade pushbuttons. Depress and latch the MANUAL pushbutton and check that the multimeter reads about 0Vdc. Check for 0Vdc on the other three pins. Release MANUAL and check that the multimeter reads +5Vdc on each pin. Failure to read any one voltage indicates that inverter U2 is probably defective. Failure to read all voltages indicates that the four-bit binary counter or MANUAL switch is probably defective. To isolate the MANUAL switch from the counter, proceed as follows: Confirm that 5Vdc exists on pin 9 at the rear of the interface cable connector attached to the A1 motherboard. Attach the shorting jumper between test points 1 and 2 and check that the multimeter reads less than the previous dc voltage. If less, then the MANUAL switch is probably defective. If dc voltage does not decrease after the shorting jumper is attached then the four-bit counter is defective. This condition can be confirmed by viewing absence of waveform on scope at pin 9 after the shorting jumper is attached.

   STROBE SWITCH, MANUAL STROBE GENERATOR, AND INVERTERS U1A–U1B. Connect oscilloscope input between pin 33 and test point 3. Set up scope for display of 0.5$\mu$s pulse (s) descending to 0 from +5Vdc. Depress STROBE pushbutton switch repeatedly and observe more than one decending pulse of the extent and magnitude given above. If no pulse is obtained, repeatedly attach shorting jumper between test points 4 and 5 and check scope for pulses. If pulses are obtained, STROBE switch is defective. If no pulses, take scope input from TRIGGER OUTPUT jack J5, and look for ascending pulses. If pulses are obtained, integrated circuit inverter U1A is defective. If no pulses are obtained either the manual strobe generator or the auto strobe generator is defective. To check the auto strobe generator, remove the previously attached shorting jumper and attach it between test points 1 and 2. Check for previously defined output pulse(s) from TRIGGER OUTPUT jack J5. If pulses are present, manual strobe generator is defective. If pulses absent, integrated circuit inverter U1B, which is part of the auto strobe generator, is defective.

AUTO STROBE GENERATOR AND AUTO SWITCH: The previous paragraph defined the procedures for checking part of the autostrobe generator that is common to the manual strobe generator. This paragraph gives the procedure for checking that portion of the auto strobe generator upstream of inverter U1B as well. Set up the scope as defined in first two sentences of the previous paragraph. Remove shorting jumper from test points 1 and 2 if previously attached. Depress and latch AUTO pushbutton on top panel of MCU. Check for repeated pulses as defined above. If pulses are present, the circuitry from the 10kHz multivibrator to AUTO switch to auto strobe generator to output at pin 33 is valid. If pulses are not present, determine from a previous paragraph that 10kHz multivibrator is valid and then apply the shorting jumper between test points 1 and 2. If pulses are present, the AUTO switch is defective. If pulses are absent, the auto strobe generator is defective. To determine which pulse forming stage in the pulse generator is defective, refer to the schematic and, using the scope, check each stage regressively from the base circuit of transistor Q4 until a waveform synched to 10kHz is found. This point defines the input to the defective stage.

SWITCHES AND INDICATOR: Troubleshooting of the pushbutton switches and indicator is done using a multimeter for either continuity or volrage checks.

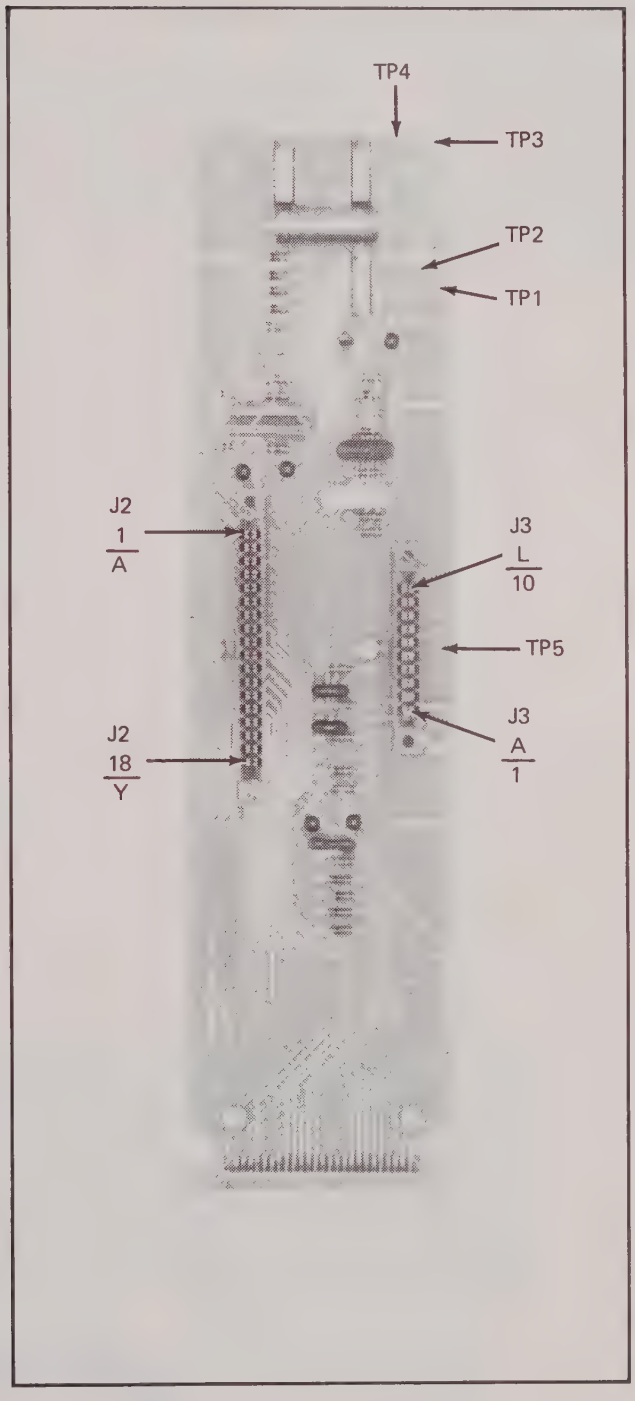



Figure 6-7. MOTHER BOARD A1
CONNECTOR ASSEMBLY PCB

TROUBLESHOOTING PROCEDURES
DRAWING NO. A4200–1800

## 6-107. LIST OF REPLACEABLE PARTS

6-108. For column entry explanations, part ordering information and basic instrument configuration Use Codes and Serial Number Effectivity List, see Section 5. See paragraph 6-109, this option subsection, for additional Use Codes and Serial Number Effectivity List assigned to this printed circuit assembly option.

## 6-109. SERIAL NUMBER EFFECTIVITY

6-110. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the Model A4200. Each part in this option for which a use code has been assigned may be identified with a particular serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all serial numbers 123 and on. NOTE: These Use Codes and Serial Number Effectivity apply to this option only.

| USE CODE | SERIAL NUMBER EFFECTIVITY |
|---|---|

| REF DESIG | DESCRIPTION | STOCK NO | TOT QTY | REC QTY | USE CODE |
|---|---|---|---|---|---|
| | **MANUAL CONTROL UNIT (Figure 6–8)** | A4200 | | | |
| A1 | CONNECTOR ASSEMBLY, PCB<br>Figure 6-9. | 303701 | 1 | | |
| A2 | PROGRAM SWITCH ASSEMBLY, PCB<br>Figure 6-10. | 303727 | 1 | | |
| A3 | FUNCTION ASSEMBLY, SWITCH PCB<br>Figure 6-11. | 303719 | 1 | | |
| | PANEL, TOP, SCREENED<br>Figure 6-8. | 303743 | 1 | | |
| | Connector, BNC, level cont. input. | 152033 | 3 | | |
| CR1 | Diode, Light Emitting | 309617 | 1 | | |
| W1 | Cable Assembly, Interface | 303354 | 1 | | |
| XCR1 | Clip, Snap-in, (diode) black | 309625 | 1 | | |
| | Panel Switch (<br>Panel Switch (interior) | 303768 | 1 | | |
| | Foot, Rubber Button, black | 130138 | 4 | | |
| | Channel, bottom | 303750 | 1 | | |
| | Switch Assemblies (see A2/Figure 6-9.<br>and A3/Figure 6-10.) | | | | |

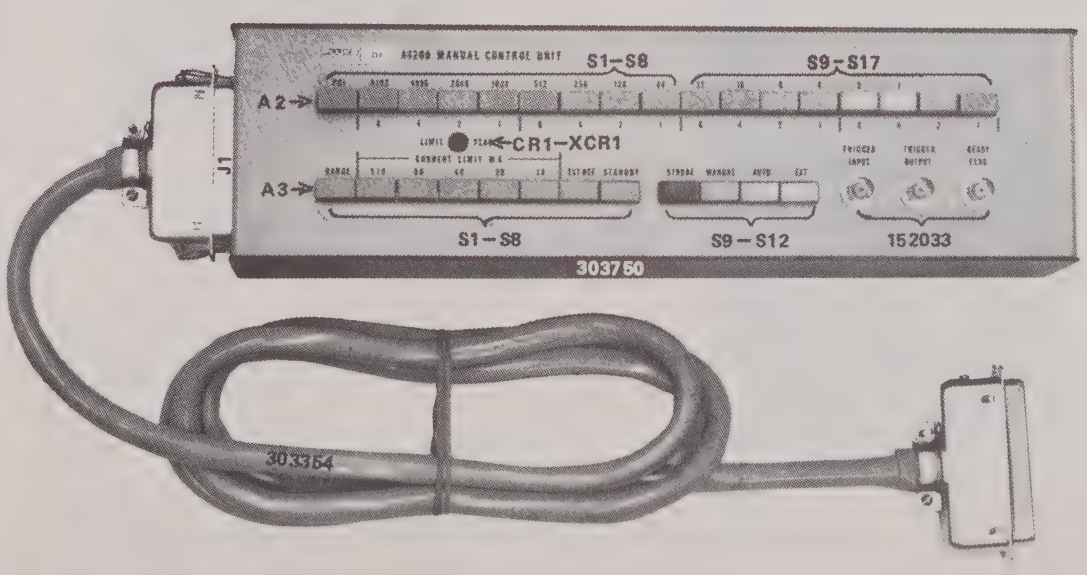
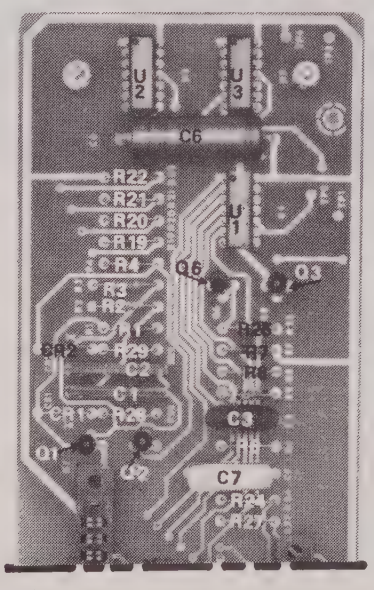



Figure 6-8 MANUAL CONTROL UNIT

| REF DESIG | DESCRIPTION | STOCK NO | TOT QTY | REC QTY | USE CODE |
|---|---|---|---|---|---|
| A1 | **CONNECTOR ASSEMBLY, PCB** **Figure 6–9.** | REF | | | |
| C1,C2 | Cap, fxd flm, .0047 uf ±2% 150v | 182972 | 2 | | |
| C3 | Cap, plstc .047 uf ±10%, 200v | 207555 | 1 | | |
| C4 | Cap, mica, 330 pf ±5%, 500v | 148445 | 1 | | |
| C5 | Cap, mica, 100 pf ±5%, 500v | 148494 | 1 | | |
| C6 | Cap, fxd, elect, 640 uf + 50/–10%, 6.4v | 178608 | 1 | | |
| C7 | Cap, plstc, .47 uf ±10%, 250v | 184366 | 1 | | |
| C8 | Cap, mica, 640 pf ± 5%, 500v | 215251 | 1 | | |
| CR1,CR2 | Diode, sil, 150 ma | 203323 | 2 | | |
| J1 | Connector, female, 50 contact | 267252 | 1 | | |
| J2 | Connector, female, 36 contact | 285247 | 1 | | |
| J3 | Connector, female, 20 contact | 292912 | 1 | | |
| Q1 thru Q5 | Xstr, Si, NPN | 159855 | 5 | | |
| Q6 | Xstr, Si, unijunction | 268110 | 1 | | |
| R1,R4,R28, R29 | Res, comp, 2.4K ±5%, 1/4w | 193433 | 4 | | |
| R2,R3 | Res, met flm 15.4K ±1%, 1/8w | 261651 | 2 | | |
| R5 | Not used | | | | |
| R6 | Res, comp, 22K ±5%, 1/4w | 148130 | 1 | | |
| R7 | Res, comp, 10K ±5%, 1/4w | 148106 | 1 | | |
| R8 | Res, comp, 39K ±5%, 1/4w | 188466 | 1 | | |
| R9 | Res, comp, 15Ω ±5%, 1/4w | 147876 | 1 | | |
| R10,R11,R17 | Res, comp, 1K | 148023 | 3 | | |
| R12,R14,R19 thru R22 | Res, comp, 3K ±5%, 1/4w | 193508 | 6 | | |
| R13 | Res, met flm, 13.7K ±1%, 1/8w | 236752 | 1 | | |
| R15,R23,R26 | Res, comp, 510Ω ±5%, 1/4w | 218032 | 1 | | |
| R16,R18,R25 | Res, comp, 390Ω ±5%, 1/4w | 147975 | 3 | | |
| R24 | Res, comp, 2.7Ω ±5%, 1/4w | 246744 | 1 | | |
| R27 | Res, comp, 270Ω ±5%, 1/4w | 160804 | 1 | | |

| REF DESIG | DESCRIPTION | STOCK NO | TOT QTY | REC QTY | USE CODE |
|---|---|---|---|---|---|
| U1 | I.C., TTL, Hex inverter, Buffer/Driver | 288605 | 1 | | |
| U2 | I.C., DTL, Quad 2–Input NAND Gate | 268375 | 1 | | |
| U3 | I.C., DTL, Binary Counter | 267153 | 1 | | |



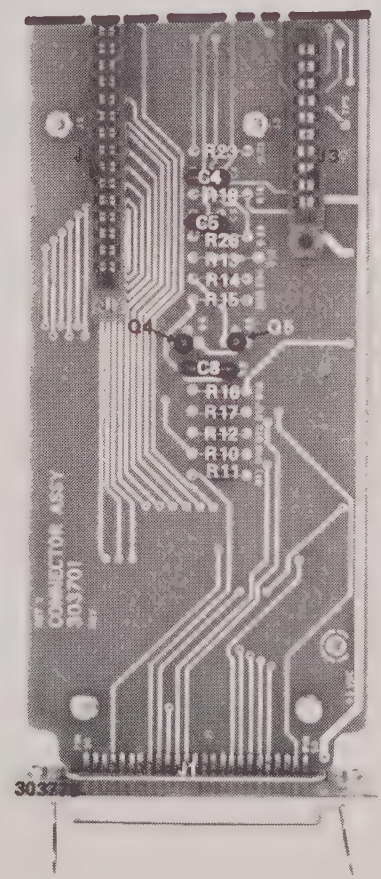




Figure 6-9. CONNECTOR ASSEMBLY PCB (A4200-4001)

| REF DESIG | DESCRIPTION | STOCK NO | TOT QTY | REC QTY | USE CODE |
|---|---|---|---|---|---|
| A2 | **PROGRAM ASSEMBLY**<br>**Figure 6–10.** | REF | | | |
| S1 thru S8 | Switch Assembly (8 pushbutton) | 306589 | 1 | | |
| S9 thru S17 | Switch Assembly (9 pushbutton) | 306571 | 1 | | |

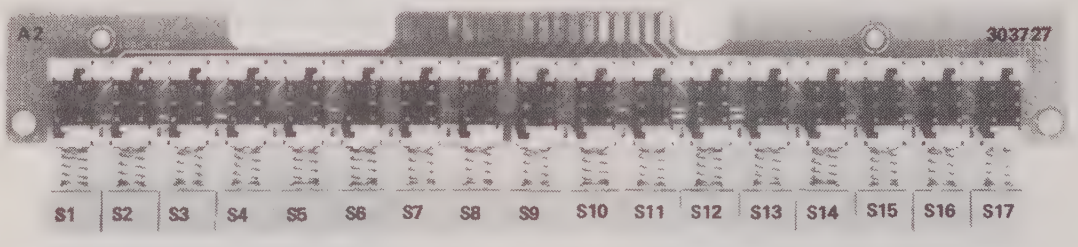



Figure 6-10. PROGRAM ASSEMBLY

| REF DESIG | DESCRIPTION | STOCK NO | TOT QTY | REC QTY | USE CODE |
|---|---|---|---|---|---|
| A3 | **FUNCTION ASSEMBLY PCB**<br>**Figure 6–11.** | REF | | | |
| R1 | Res, comp, 51Ω ±5%, 1/4w | 221879 | 1 | | |
| S1 thru S8 | Switch Assembly (8 pushbutton) | 306589 | 1 | | |
| S9 thru S12 | Switch Assembly (4 pushbutton) | 306597 | 1 | | |
| | Connector pin | 267500 | 6 | | |

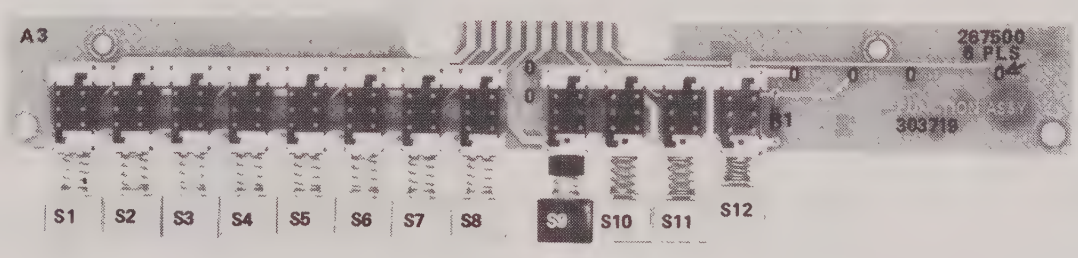
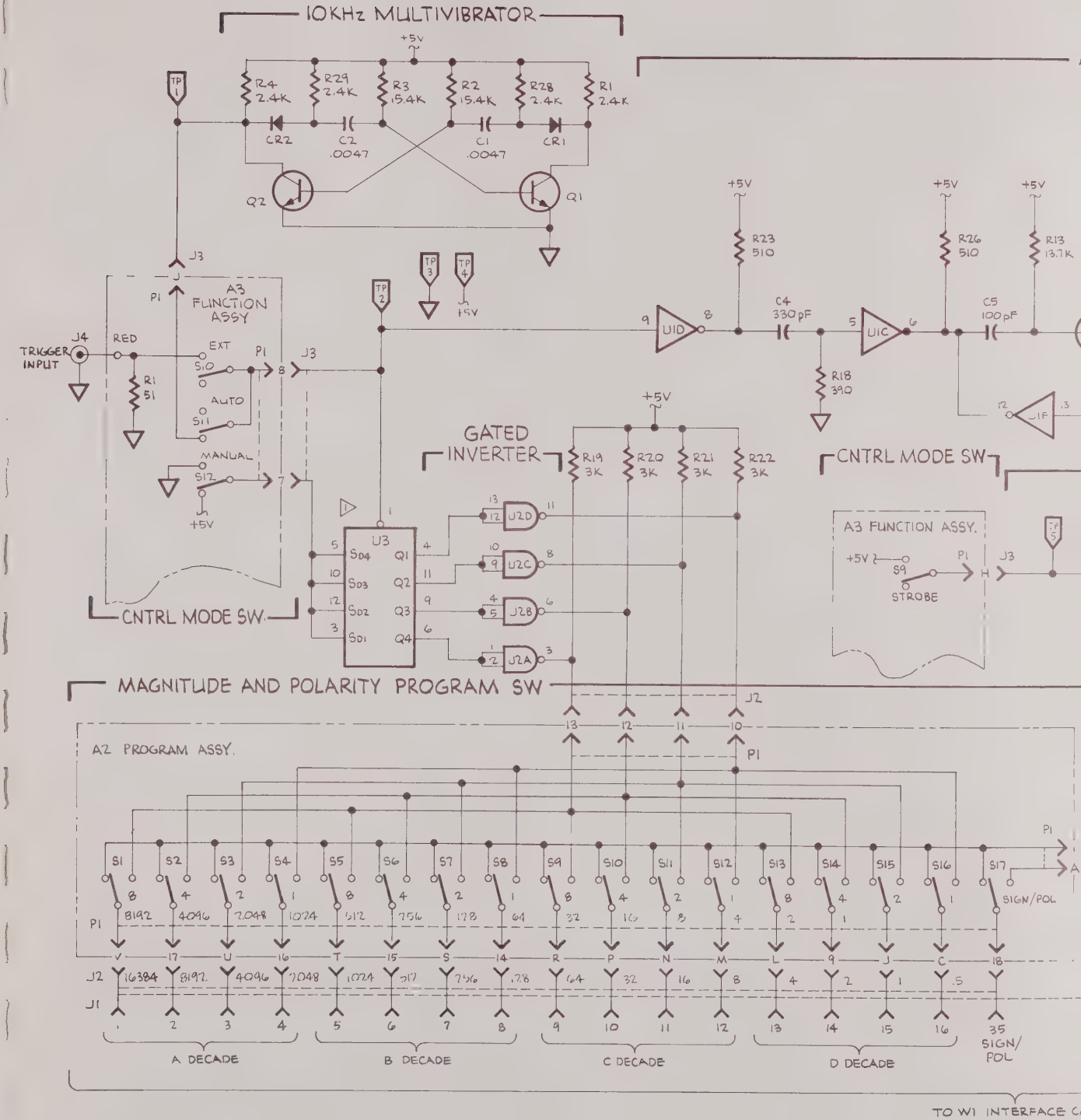
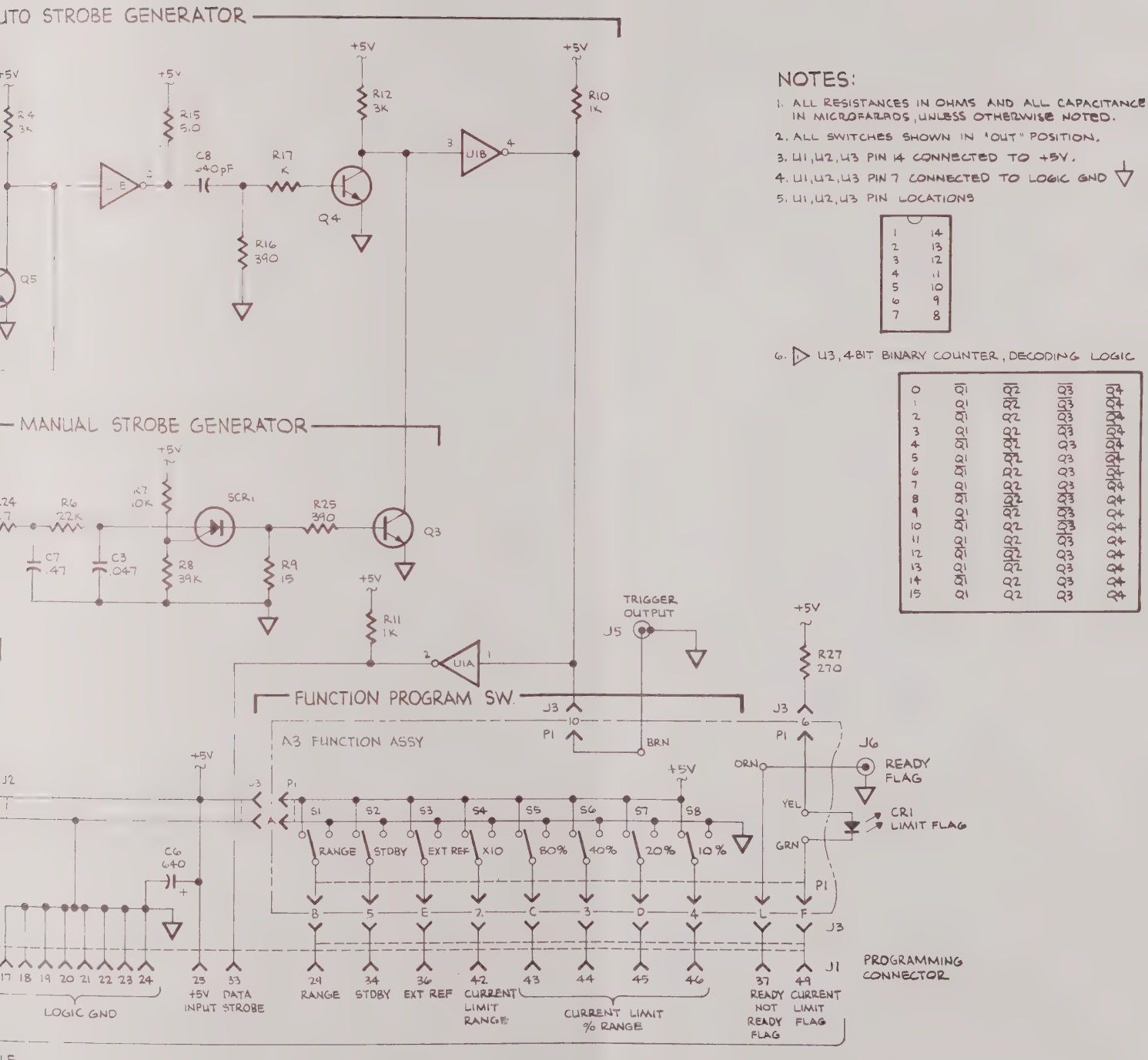



Figure 6-11. FUNCTION ASSEMBLY

## MANUFACTURERS' CROSS REFERENCE LIST

| FLUKE STOCK NO. | MFR. | MFR. PART NO. |
|---|---|---|
| 130138 | 70485 | 366 |
| 147876 | 01121 | CB1505 |
| 147975 | 01121 | CB3915 |
| 148023 | 01121 | CB1025 |
| 148106 | 01121 | CB1035 |
| 148130 | 01121 | CB2235 |
| 148445 | 14655 | CD15F330J |
| 148494 | 14655 | CD15F101J |
| 152033 | 02660 | UG1094A/U |
| 159855 | 07910 | CS23030 |
| 160804 | 01121 | CB2715 |
| 178608 | 73445 | C437ARC640 |
| 182972 | 02799 | PE–472–G |
| 184366 | 73445 | C280AE/A470K |
| 188466 | 01121 | CB3935 |
| 193433 | 01121 | CB2425 |
| 193508 | 01121 | CB3025 |
| 203323 | 03508 | DHD1105 |
| 207555 | 14655 | DMF2S47 |
| 215251 | 14655 | CD19F641J |
| 218032 | 01121 | CB5115 |
| 221879 | 01121 | CB5105 |
| 236752 | 91637 | Type MFF 1/8 |
| 246744 | 01121 | CB27G5 |
| 261651 | 91637 | Type MFF 1/8 |
| 267153 | 04713 | MC839P–6921 |
| 267252 | 02660 | 57–40500 |
| 267500 | 00779 | 86144–2 |
| 268110 | 03508 | D13T1 |
| 268375 | 04713 | MC846P |
| 285247 | 02660 | 225-21821-110 |
| 288605 | 01295 | SN7416N |
| 292912 | 02660 | 225–21021–110 |
| 303354 | 89536 | 303354 |
| 303701 | 89536 | 303701 |
| 303743 | 89536 | 303743 |
| 303750 | 89536 | 303750 |
| 303719 | 89536 | 303719 |
| 303727 | 89536 | 303727 |
| 303768 | 89536 | 303768 |
| 306571 | 89536 | 306571 |
| 306597 | 89536 | 306597 |
| 306589 | 89536 | 306589 |
| 309617 | 71318 | FLV102 |
| 309625 | 07263 | FVC 001T |


10KHz MULTIVIBRATOR
+5V
TP 1
R4 2.4K
R29 2.4K
R3 15.4K
R2 15.4K
R28 2.4K
R1 2.4K
CR2
C2 .0047
C1 .0047
CR1
Q2
Q1
J3
A3 FUNCTION ASSY
P1
TP 2
TP 3
TP 4
+5V
J4
TRIGGER INPUT
RED
R1 51
EXT
S10
AUTO
S11
MANUAL
S12
+5V
P1
J3
CNTRL MODE SW.
U1D
C4 330 pF
U1C
C5 100 pF
R23 510
R26 510
R13 13.7K
R18 390
.1F
GATED INVERTER
R19 3K
R20 3K
R21 3K
R22 3K
U3
SD4
SD3
SD2
SD1
Q1
Q2
Q3
Q4
U2D
U2C
U2B
U2A
CNTRL MODE SW
A3 FUNCTION ASSY.
+5V
S9
STROBE
P1
J3
MAGNITUDE AND POLARITY PROGRAM SW
J2
A2 PROGRAM ASSY.
P1
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
S14
S15
S16
S17
SIGN/POL
8192
4096
2048
1024
512
256
128
64
32
16
8
4
2
1
V
U
T
S
R
P
N
M
L
K
J
C
B
J2
16384
8192
4096
2048
1024
512
256
128
64
32
16
8
4
2
1
.5
J1
A DECADE
B DECADE
C DECADE
D DECADE
35 SIGN/ POL
TO W1 INTERFACE C




## NOTES:

1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCE IN MICROFARADS, UNLESS OTHERWISE NOTED.
2. ALL SWITCHES SHOWN IN "OUT" POSITION.
3. U1, U2, U3 PIN 14 CONNECTED TO +5V.
4. U1, U2, U3 PIN 7 CONNECTED TO LOGIC GND
5. U1, U2, U3 PIN LOCATIONS

| | |
|---|---|
| 1 | 14 |
| 2 | 13 |
| 3 | 12 |
| 4 | 11 |
| 5 | 10 |
| 6 | 9 |
| 7 | 8 |

6. U3, 4-BIT BINARY COUNTER, DECODING LOGIC

| | | | | |
|---|---|---|---|---|
| 0 | Q1 | Q2 | Q3 | Q4 |
| 1 | Q1 | Q2 | Q3 | Q4 |
| 2 | Q1 | Q2 | Q3 | Q4 |
| 3 | Q1 | Q2 | Q3 | Q4 |
| 4 | Q1 | Q2 | Q3 | Q4 |
| 5 | Q1 | Q2 | Q3 | Q4 |
| 6 | Q1 | Q2 | Q3 | Q4 |
| 7 | Q1 | Q2 | Q3 | Q4 |
| 8 | Q1 | Q2 | Q3 | Q4 |
| 9 | Q1 | Q2 | Q3 | Q4 |
| 10 | Q1 | Q2 | Q3 | Q4 |
| 11 | Q1 | Q2 | Q3 | Q4 |
| 12 | Q1 | Q2 | Q3 | Q4 |
| 13 | Q1 | Q2 | Q3 | Q4 |
| 14 | Q1 | Q2 | Q3 | Q4 |
| 15 | Q1 | Q2 | Q3 | Q4 |

| REV | DESCRIPTION |
|---|---|
| 1 | REDRAWN |

# MANUAL CONTROL UNIT

## A4200 - 1000

DATE: SEPTEMBER, 1972

# Accessory
# Rack Mounting Fixtures

## 6-1. INTRODUCTION

6-2. The Accessory Rack Mounting Kits are of two general types: half-rack width and full-rack width. The half-rack width mountings are further divided into dual mountings, center mountings, and offset mountings. Chassis Slide Kits, which enable withdrawl of the rack mounted instrument for inspection and servicing, can be installed on full-width rack instruments and on half-rack width instruments when in the dual mounting configuration. Figure 6-1 shows the variations possible in rack mountings and the configurations which can use chassis slides, all variations related to the standard 19-inch equipment rack.

## 6-3. INSTALLATION PROCEDURES

### 6-4. Half-Rack Width Mountings

6-5. The half-rack width mountings are shown in Figure 6-1 as A, B, and C. The full-rack mounting is shown as D. To install the mountings shown in Figure 6-1 B through D, proceed as follows:

a. Disconnect the line power cord.

b. Peel the decal shown in Figure 6-2 from each front side panel.

c. Install the mounting brackets on each front side panel using the #8-32 x 1/2" PHP screws provided in the kit. The mounting brackets for offset installation can be installed on either side, as desired.

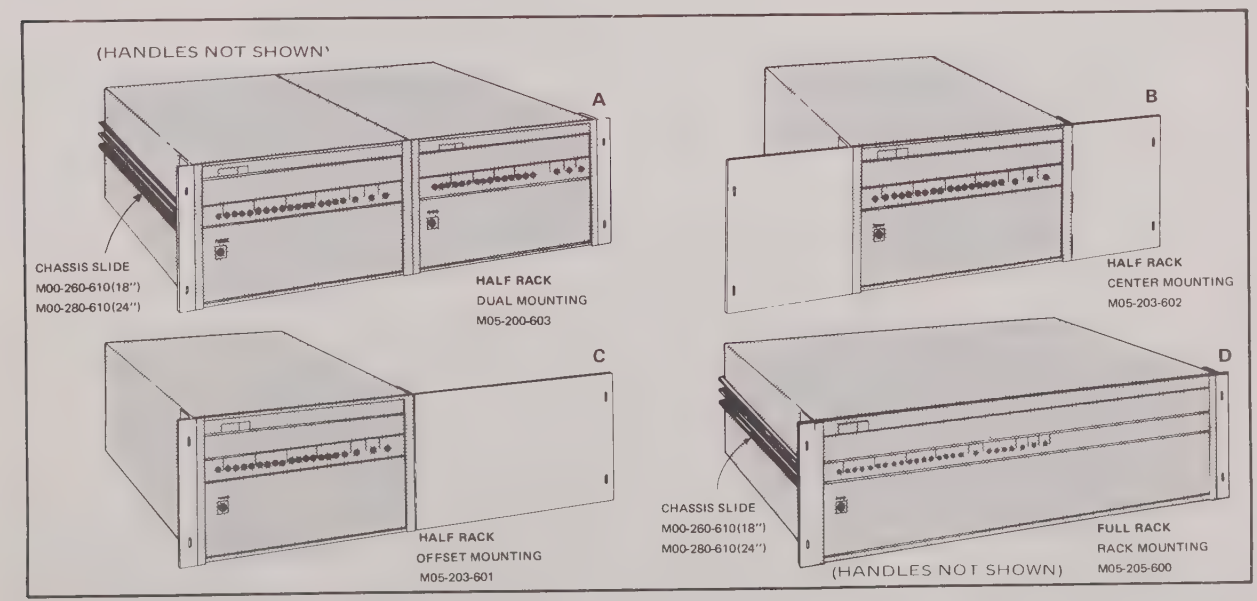



Figure 6-1. ACCESSORY RACK MOUNTING KITS

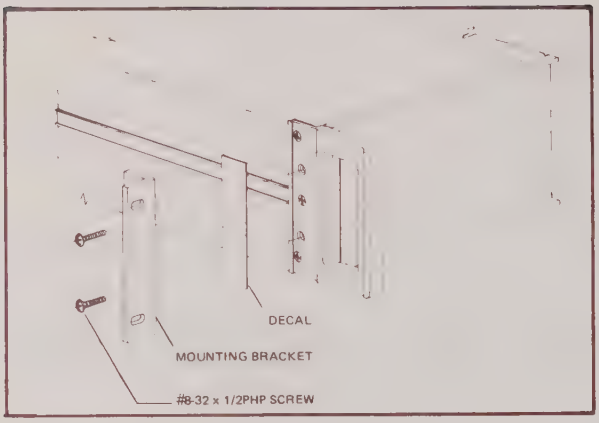



Figure 6-2. RACK MOUNTING BRACKET INSTALLATION

d. Remove the feet from the bottom dust cover.

e. Slide the instrument into the equipment rack and secure it in place with fasteners through the mounting brackets.

*NOTE!*

*Chassis slides should be installed on the full-rack width units. See Figure 6-1, A.*

f. Connect the power cord to line power.

## 6-6. Half-Rack Dual Units Installation

6-7. Two half-rack width instruments can be installed side-by-side in an equipment rack using the M05-200-603 Rack Mounting Kit. To install these components and mount the units in the equipment rack, proceed as follows:

a. Ensure that the power cord of each instrument is disconnected from line power.

b. Peel the front and rear side panel decals from each instrument.

c. Select one instrument and remove the top and bottom dust covers.

d. Remove the guard cover.

e. Remove the three screws from the front side panel that will mate to the other instrument.

f. Pull the front panel forward slightly and then thread the #8-32 fasteners into the P-nuts shown in Figure 6-3.

g. Push the front panel into position, making sure that each PCB is correctly mated into the mother board PCB, and then install the three screws in the front side panel.

h. Thread the #8-32 fasteners into the P-nuts located on the inner rear side panel that will mate to the other instrument.

i. Bolt the two instruments together as shown in Figure 6-3.

j. Install the guard cover removed in step d.

k. Remove the feet from the bottom dust cover of each instrument.

l. Install the top and bottom dust covers removed in step b.

m. Install the mounting brackets shown in Figure 6-2 on the outer front side panels. Use the #8-32 x 1/2" PHP screws provided in the kit.

n. Slide the two instruments into the equipment rack and secure them in place with fasteners through the mounting brackets.

*NOTE!*

*Refer to paragraph 6-8 for chassis slide installation.*

o. Connect the power cords to line power.

## 6-8. Chassis Slide Installation

6-9. The M00-260-610 (18") or M00-280-610 (24") Chassis Slide Kit should be installed to better facilitate dual rack mounting or installation of full-width rack units. To

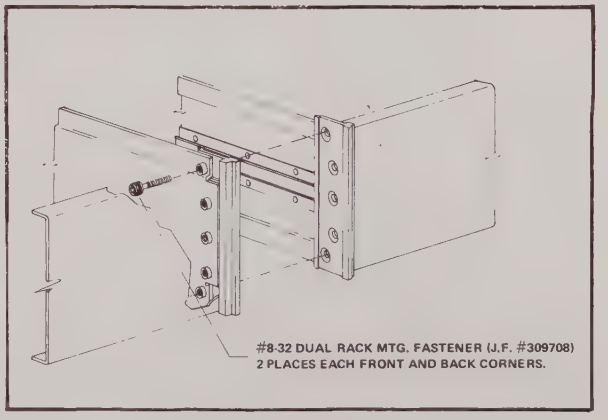



Figure 6-3. DUAL RACK MOUNTING

install these components and mount the units or unit in the equipment rack, proceed as follows:

a. Peel the center side panel decals from the instrument.

b. Peel the rear side panel decals from the instrument.

c. Remove the six screws from the rear panel corner brackets and then remove the brackets.

d. Slide the spacer (A) into the center section of the side panel until the tapped holes are aligned with the holes in the side panels.

e. Scribe a line on spacer where it protrudes from the rear of the side panel and then remove it from the instrument.

f. Cut off the spacer at the scribe mark and then install it in the side panel.

g. Install the rear panel corners.

h. Attach the chassis section (B) to the side panels with the screws (C) provided in the kit.

i. Install the cabinet sections (E) and center sections (D) in equipment rack. The extension angle brackets, which are part of section (E), are mounted at the rear of the cabinet.

j. Slide the center sections (D) toward the front of the cabinet until they lock in place.

k. Depress the spring locks on the chassis sections (B) and insert the instrument between the extended center sections (D) on the cabinet.

l. Slide the instrument completely into the equipment rack and secure in place with fasteners through the mounting brackets.

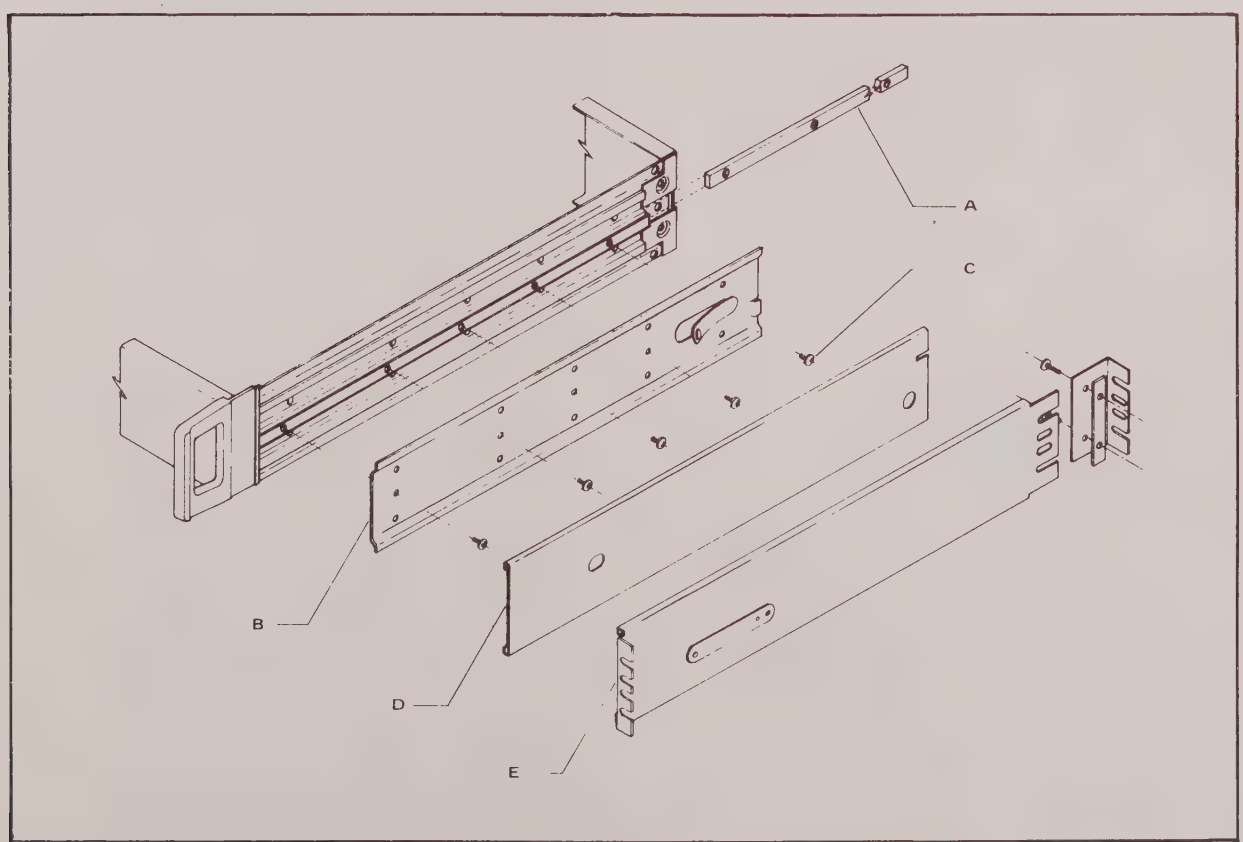



Figure 6-4. CHASSIS SLIDE INSTALLATION

# Accessory
# Programming Connector

## 6-1. INTRODUCTION

6-2. The Amphenol, male, programming connector shown in Figure 6-1 is used to interface the instrument to a programming source. This male programming connector mates with the female programming connector that is mounted on the rear panel of the instrument. A male connector is normally supplied with each instrument, less cabling, but may also be ordered directly from Amphenol under PART NO. 57-30500, or from the John Fluke Mfg. Co., Inc., by referencing FLUKE PART NO. 266056.

## 6-3. ASSEMBLY INSTRUCTIONS

6-4. Cabling connections to the male programming connector are done as follows:

a. Remove the screws from the terminal cover of the male connector and remove the cover and numbered terminal/pin insert.

b. Remove the screws from the restraining clamps on the cover and spread the clamps.

c. Thread the cable wiring through the terminal cover. Maximum size is #22.

d. Solder the wiring to the appropriate terminals of the numbered insert. Refer to Figure 6-1 for terminal locations. Use pin cover to support insert during soldering.

e. Slide the covers together and install the attaching screws.

f. Close the restraining clamp around the cable and install the screws. If necessary, wrap the wiring bundle to provide a proper diameter for the restraining clamp.

g. Connect the male programming connector to the female connector on the rear panel of the instrument. Fasten them securely with the end clips.

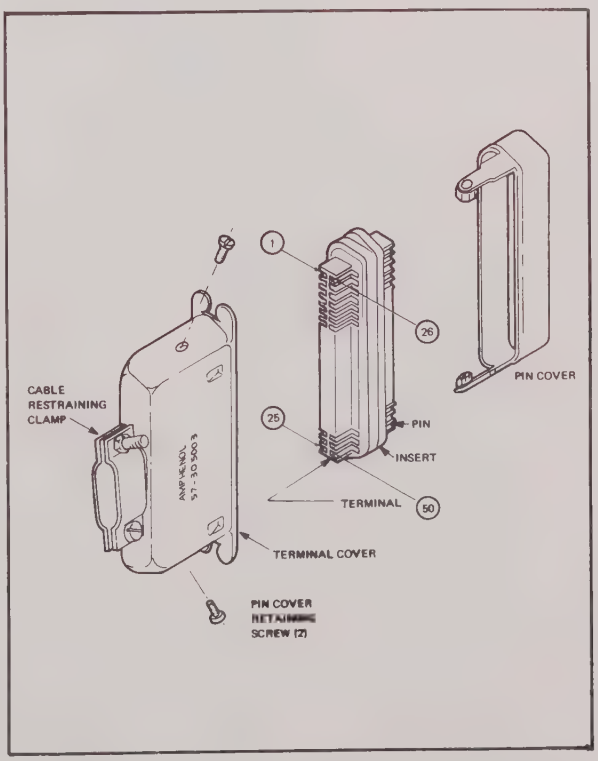



Figure 6-1. MALE PROGRAMMING CONNECTOR

Accessories

# Extender PCB Assembly and Cable Extender Assembly

## 6-1. INTRODUCTION

6-2. The Extender PCB Assembly shown in Figure 6-1 is available as an accessory for the FLUKE series of 4200 power sources. This accessory permits the printed circuit boards in the power source to be extended for servicing. The Extender PCB Assembly can be obtained by ordering FLUKE PART NO. 292623.

## 6-3. INSTALLATION

### 6-4. Extender PCB Assembly

6-5. To install a printed circuit board on the extender as shown in Figure 6-2, proceed as follows:

a. Turn off the power source, remove the line power cord, and then remove the top dust cover and guard cover.

b. Locate the printed circuit board to be serviced and remove it using the information given in Section 4, MAINTENANCE ACCESS.

c. Install the extender into the mother board connector as shown in Figure 6-2.

d. Support the extender and install the printed circuit board into the extender connector as shown in Figure 6-2.

**CAUTION!**

**THE COMPONENT SIDE OF THE PRINTED CIRCUIT BOARD THAT IS INSERTED INTO THE EXTENDER CONNECTOR MUST FACE THE FRONT OF THE INSTRUMENT.**

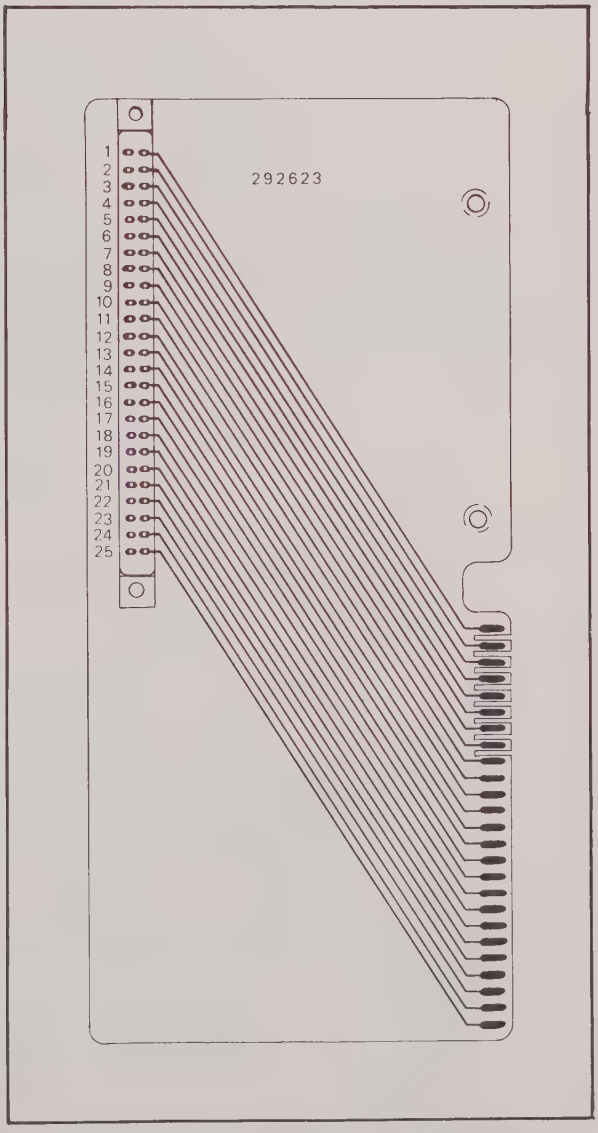



Figure 6-1. PCB ASSEMBLY EXTENDER

## 6-6. Cable Extender Assembly

a. The removal of certain interconnected printed circuit boards requires the use of a cable extender assembly to reconnect the board to its original electrical configuration after the board is inserted into the extender PCB. The cable extender assembly is shown in Figure 6-3, and is obtained by ordering FLUKE PART NO. 337584.

b. Usage of the cable extender assembly is shown in Figures 6-4 and 6-5 for the instruments requiring its use. Normally the cable extender assembly is not used with the 4210A/4216A instruments unless troubleshooting of the power supply PCB would require separating and remotely locating the ac input power controls and input transformer. The cable extender assembly would join the ac input power controls and input transformer to the power supply PCB.

c. After the extender PCB assembly and test PCB and, where required, the cable extender assembly are connected, the power can be applied.

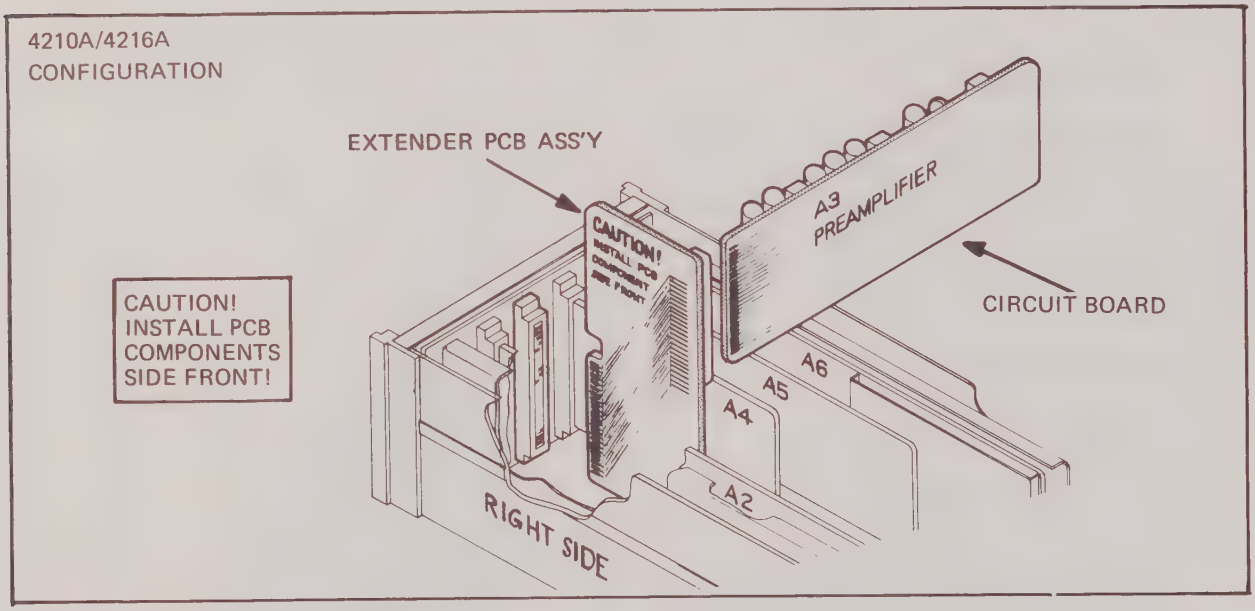



Figure 6-2. EXTENDER PCB ASSEMBLY INSTALLED IN 4210A/4216A INSTRUMENT

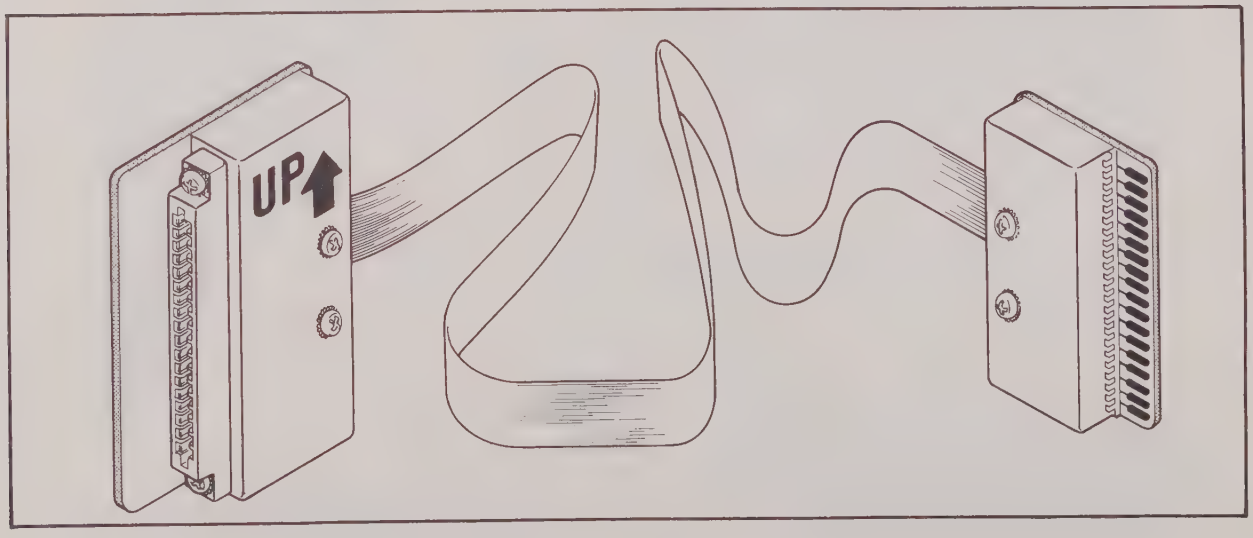



Figure 6-3. CABLE EXTENDER ASSEMBLY

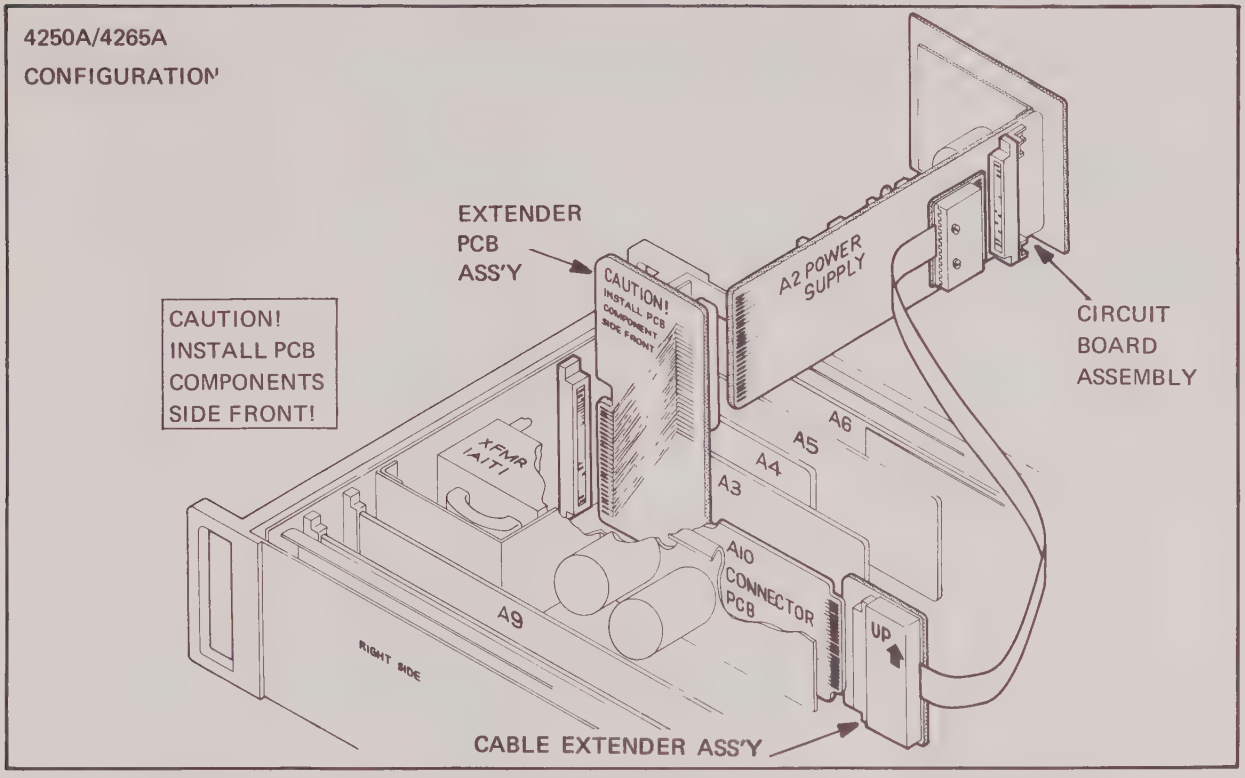



Figure 6-4. EXTENDER PCB AND CABLE EXTENDER ASSEMBLIES INSTALLED IN 4250A/4265A INSTRUMENTS

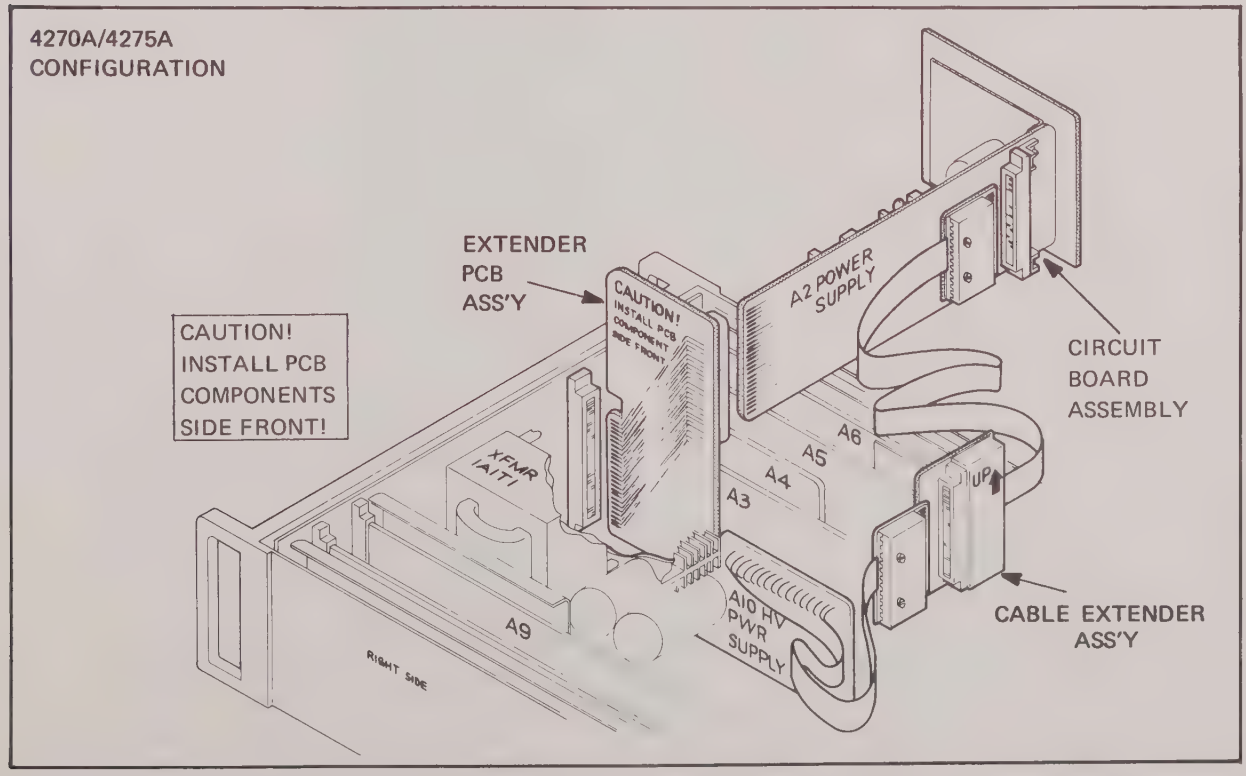



Figure 6-5. EXTENDER PCB AND CABLE EXTENDER ASSEMBLIES INSTALLED IN 4270A/4275A INSTRUMENTS

# Section 7
# General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the Lists of Replaceable parts contained in Section 5. The following information is presented in this section:


| TABLE | TITLE | PAGE |
|---|---|---|
| 7-1. | List of Abbreviations | 7-2 |
| 7-2. | Federal Supply Codes for Manufacturers | 7-3 |
| 7-3. | Fluke Technical Service Centers | 7-7 |
| 7-4. | International Service Centers | 7-7 |
| 7-5. | Sales Representatives-Domestic | 7-8 |
| 7-6. | Sales Representatives-International | 7-9 |

## Table 7-1. LIST OF ABBREVIATIONS AND SYMBOLS

| | |
|---|---|
| A or amp | ampere |
| ac | alternating current |
| af | audio frequency |
| a/d | analog-to-digital |
| assy | assembly |
| AWG | american wire gauge |
| B | bel |
| bcd | binary coded decimal |
| $^{o}C$ | Celsius |
| cap | capacitor |
| ccw | counterclockwise |
| cer | ceramic |
| cermet | ceramic to metal(seal) |
| ckt | circuit |
| cm | centimeter |
| cmrr | common mode rejection ratio |
| comp | composition |
| cont | continue |
| crt | cathode-ray tube |
| cw | clockwise |
| d/a | digital-to-analog |
| dac | digital-to-analog converter |
| dB | decibel |
| dc | direct current |
| dmm | digital multimeter |
| dvm | digital voltmeter |
| elect | electrolytic |
| ext | external |
| F | farad |
| $^{o}F$ | Fahrenheit |
| FET | Field-effect transistor |
| ff | flip-flop |
| freq | frequency |
| FSN | federal stock number |
| g | gram |
| G | giga ($10^{9}$) |
| gd | guard |
| Ge | germanium |
| GHz | gigahertz |
| gmv | guaranteed minimum value |
| gnd | ground |
| H | henry |
| hd | heavy duty |
| hf | high frequency |
| Hz | hertz |
| IC | integrated circuit |
| if | intermediate frequency |
| in | inch(es) |
| intl | internal |
| I/O | input/output |
| k | kilo ($10^{3}$) |
| kHz | kilohertz |
| kΩ | kilohm(s) |
| kV | kilovolt(s) |
| lf | low frequency |
| LED | light-emitting diode |
| LSB | least significant bit |
| LSD | least significant digit |
| M | mega ($10^{6}$) |
| m | milli ($10^{-3}$) |
| mA | milliampere(s) |
| max | maximum |
| mf | metal film |
| MHz | megahertz |
| min | minimum |
| mm | millimeter |
| ms | millisecond |
| MSB | most significant bit |
| MSD | most significant digit |
| MTBF | mean time between failures |
| MTTR | mean time to repair |
| mV | millivolt(s) |
| mv | multivibrator |
| MΩ | megohm(s) |
| n | nano ($10^{-9}$) |
| na | not applicable |
| NC | normally closed |
| (–) or neg | negative |
| NO | normally open |
| ns | nanosecond |
| opnl ampl | operational amplifier |
| p | pico ($10^{-12}$) |
| para | paragraph |
| pcb | printed circuit board |
| pF | picofarad |
| pn | part number |
| (+) or pos | positive |
| pot | potentiometer |
| p-p | peak-to-peak |
| ppm | parts per million |
| PROM | programmable read-only memory |
| psi | pound-force per square inch |
| RAM | random-access memory |
| rf | radio frequency |
| rms | root mean square |
| ROM | read-only memory |
| s or sec | second (time) |
| scope | oscilloscope |
| SH | shield |
| Si | silicon |
| serno | serial number |
| sr | shift register |
| Ta | tantalum |
| tb | terminal board |
| tc | temperature coefficient or temperature compensating |
| tcxo | temperature compensated crystal oscillator |
| tp | test point |
| u or μ | micro ($10^{-6}$) |
| uhf | ultra high frequency |
| us or μs | microsecond(s) ($10^{-6}$) |
| uut | unit under test |
| V | volt |
| v | voltage |
| var | variable |
| vco | voltage controlled oscillator |
| vhf | very high frequency |
| vlf | very low frequency |
| W | watt(s) |
| ww | wire wound |
| xfmr | transformer |
| xstr | transistor |
| xtal | crystal |
| xtlo | crystal oscillator |
| Ω | ohm(s) |
| μ | micro ($10^{-6}$) |

## Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisberg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884 - use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571 - use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
Ross Milton, Co., The
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Division
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, MA

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933 - use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept.
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988 - use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, MN

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp
Rectifier Division
Hickville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Division
AMF Canada LTD.
Guelph, Onatrio, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
Budd Co. The, Polychem Products
Plastic Products Div.
Bridgeport, PA

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606 - use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors, formerly
Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
G T E Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Buckeye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co. Corporate H.Q.
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
A B Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
Mallory, P.R. & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp, formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, Californai

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnbach Radio Co., Inc.
Freeport, LI New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village, Chicago, Illinois

72005
Driver, Wilber B., Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrence, California

73445
Amperex Electronic Corp.
Hicksville, LI, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp., Mepco Div.
A North American Phillips Co.
Morristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183 - use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Stevens, Arnold Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81439
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

82415
North American Phillips
Controls Corp.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
Carr Co., The United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Division
Eatontown, New Jersey

83330
Smith, Herman H., Inc.
Brooklyn, New York

83478
Rubbercraft Corp. of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div.
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc.
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products,
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
Fluke, John Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

90201
Mallory Capacitor Co. Div of
P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211 - use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737 - use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154 - use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
Chicago, Illinois

96733
San Fernando Electric Mfg. Co.
San Fernando, California

96853
Gulton Industries Inc.
Measurement and Controls Div.
formerly Rustrak Instruments Co.
Manchester, New Hampshire

96881
Thomson Industries, Inc.
Manhasset, New York

97540
Master Mobile Mounts
Div. of Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic Hdware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect. Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779 - use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
Centrelab Semiconductor
Centrelab Electronics Div. of
Globe-Union Inc.
El Monte, California

Toyo Electronics
(R-Ohm Corp.)
Irvine, California

National Connector
Minneapolis, Minnesota

## Table 7-3. FLUKE TECHNICAL SERVICE CENTERS

### United States

**CALIFORNIA**

**Burbank**
Fluke Western Tecnical Center
Mike Nagy, Service Manager
2020 N. Lincoln St.
Zip: 91504
Tel. (213) 849-4641

**Santa Clara**
Fluke Western Technical Center
Tom Marshall, Service Manager
2359 De La Cruz Blvd.
Zip: 95050
Tel. (408) 985-1200

**COLORADO**

**Denver**
Fluke Southwestern
Technical Center
Mel Suelzle, Service Manager
1980 S. Quebec St.
Unit 4
Zip: 80231
Tel. (303) 750-1228

**FLORIDA**

**Orlando**
Fluke S.E. Technical Center
Jesse Morse, Service Manger
P.O. Box 6578
940 N. Fern Creek Ave.
Zip: 32803
Tel. (305) 896-2296

**ILLINOIS**

**Des Plaines**
Fluke Midwestern
Technical Center
Bruce Hunt, Service Manager
1287 N. Rand Road
Zip: 60016
Tel. (312) 298-7470

**MARYLAND**

**Kensington**
Fluke Mideastern
Technical Center
John Hines, Service Manager
11501 Huff Court
Zip: 20795
Tel. (301) 881-5300

**MASSACHUSETTS**

**Lexington**
Fluke N.E. Technical Center
Dick Zemba, Service Manager
109 Massachusetts Ave.
Zip: 02173
Tel. (617) 861-8620

**MINNESOTA**

**Minneapolis**
Fluke Midwestern
Technical Center
Robert Wayne, Br. Manager
10800 Lyndale Ave. So.
Zip: 55420
Tel. (612) 884-4541

**NEW JERSEY**

**Totowa**
Fluke Eastern Technical Center
Al La Fleur, Service Manager
500 Union Blvd.
Zip: 07512
Tel. (201) 742-3215

**NEW YORK**

**Farmingdale, LI**
Fluke Eastern Technical Center
Charles Vanek, Br. Manager
59Central Ave. Unit 3
Zip: 11735
Tel. (516) 752-1078

**Rochester**
Fluke Eastern Technical Center
Wayne Roth, Br. Service Manager
4515 Culver Road
Zip: 14622
Tel. (716) 342-6940

**NORTH CAROLINA**

**Greensboro**
Fluke S.E. Technical Center
Dwain Cox, Service Manager
P.O. Box 9619
1310 Beaman Place
Zip: 27408
Tel. (919) 273-1918

**WASHINGTON**

**Mountlake Terrace**
John Fluke Mfg. Co., Inc.
Bill Fetrow, Tech. Service Spvr.
7001 - 220th Ave. S.W.
Zip: 98043
Tel. (206) 774-2206

### Canada

**ALBERTA**

**Calgary**
Fluke Canadian Technical Center
Dave Racinsky, Service Manager
3829 - 12th St. N.E.
Zip: T2E 6M5
Tel. (403) 261-0780

**ONTARIO**

**Mississauga**
Fluke Canadian Technical Center
Herb Duval, Service Manager
6427 Northam Drive
Zip: L4V 1J5
Tel. (416) 678-1500

## Table 7-4. INTERNATIONAL SERVICE CENTERS

### CENTRAL & SOUTH AMERICA

**ARGENTINA**
Coasin S.A.
Miguel Volpe, Service Manager
Virrey del Pino 4071
**Buenos Aires,** Argentina
Tel: 523185

**BRAZIL**
Ambriex S.A.
Col. Josue Dantas Martins Filho
Rua Ceara, 104 - 2° e 3° Andares
ZC-29
**Rio de Janeiro GB,** Brazil
Tel: 264-7406

Adolfo Toyomaro Ichiki,
Service Manager
Rua Tupi, 535
01233 **Sao Paulo SP,** Brazil
Tel: 52-7806 & 0912

**ECUADOR**
Proteco Coasin CIA, Ltda.
Ing Jaime Jaramillo
Apartado 228A
**Quito,** Ecuador
Tel: 526759

**MEXICO**
Mexitek, S.A.
Enrique Batista Mangas,
Service Manager
Eugenia 408
Department 1
**Mexico** 12, D.F.
Mexico
Tel: 5360910 - 5239751

**VENEZUELA**
Coasin C.A.
Leslie Dunia, Service Manager
Apdo. Postal 50939
Sabana Grande No. 1
**Caracas** 105, Venezuela
Tel: 722311 - 728662

### EUROPE

**FRANCE**
M.B. Electronique S.A.
Serge Pison, Service Manager
29, Rue Emile Duclaux
92150, **Suresnes,** France
Tel: 7723111 (108)

**NETHERLANDS**
C.N. Rood N.V.
Sieb Hoekstra, Service Manager
Cort van der Lindenstraat 11-13
P.O. Box 42
**Rijswijk** ZH 2100
Tel: 070-996360

Fluke (Nederland) B.V.
Henk Lit, Service Manager
P.O. Box 5053
Zevenheuvelenweg 53
**Tilburg,** Netherlands
Tel: (13) 673973

**NORWAY**
Morgenstierne & Co. A/S
Finn Schjervan
Konghellegate 3
P.O. Box 6688, Rodelokka
**Oslo** 5, Norway
Tel: 472 356110

**UNITED KINGDOM**
Fluke International Corporation
Ed Cutter, Service Manager
Garnet Close
**Watford,** WD2 4TT
England
Tel: 0923-33066

### AFRICA, ASIA & AUSTRALIA

**AUSTRALIA**
Elmeasco Instruments Pty. Ltd.
Andrew McKean,
Service Manager
P.O. Box 30
**Concord,** N.S.W.
Australia 2137
Tel: (02) 736-2888

**HONG KONG**
Gilman & Co., Ltd.
J.B. Tetlow
P.O. Box 56
**Hong Kong**
Tel: 227011 (14)

**INDIA**
Hinditron Services Pvt. Ltd.
Chandu Vagal,
Service Manager
69/A.L. Jagmohandas Marg
**Bombay** —400 006, India
Tel: 365344

**IRAN**
Berkeh Company Ltd.
Tom Payne
20 Salm Road, Roosevelt Ave.
**Tehran,** Iran
Tel: 828294 831564

**ISRAEL**
R.D.T. Electronics Engineering Ltd.
Shamai Ram-nof,
Service Manager
46, Sokolov Street
**Ramat Hasharon** 47235 Israel
Tel: 483211

**JAPAN**
Toyo Trading Company Ltd.
Mr. Adachi, Service Manager
P.O. Box 5014
International Tokyo
**Tokyo** 100-31, Japan
Tel: (03) 279-0771

**SOUTH AFRICA**
Fluke (Pty) Ltd.
P.O. Box 13091
**Benoni** 1511
Transvaal
Republic of South Africa
Tel: 011-849-6811

For areas not listed, contact the Fluke Technical Center nearest you or contact Fluke directly at Mountlake Terrace, WA.

**John Fluke Mfg. Co., Inc.**
P.O. Box 43210, Mountlake Terrace, WA 98043
Tel: (206) 774-2211 Toll Free: (800) 426-0361 TWX: 910-449-2850 Telex: 32-0013 Cable: Fluke

## United States

### ALABAMA
**Huntsville**
BCS Associates, Inc.
P.O. Box 1273
3322 S. Memorial Parkway
Zip: 35807
Tel. (205) 881-6220

### ALASKA
**Anchorage**
Harry Lang & Associates
1406 W. 47th Ave.
Zip: 99503
Tel. (907) 279-5741

### ARIZONA
**Phoenix**
Barnhill Associates, Inc.
7319 E. Stetson Drive
Scottsdale, AZ 85251
Tel. (602) 947-7841

### CALIFORNIA
**Los Angeles**
Instrument Specialists
Sales Group
John Fluke Mfg. Co., Inc.
2020 North Lincoln Street
Burbank, CA 91504
Tel. (213) 849-7181

**Santa Clara**
Instrument Specialists
Sales Group
John Fluke Mfg. Co., Inc.
2359 De La Cruz Blvd.
Zip: 95050
Tel. (408) 244-1505

### COLORADO
**Denver**
Barnhill Associates, Inc.
1980 S. Quebec Street, Unit 4
Zip: 80231
Tel. (303) 750-1222

### CONNECTICUT
**Hartford**
IRI Sales Group
John Fluke Mfg. Co., Inc.
P.O. Box 518
Glastonbury, CT 06033
Tel. (203) 633-0777

### FLORIDA
**Orlando**
BCS Associates, Inc.
P.O. Box 6578
940 N. Fern Creek Ave.
Zip: 32803
Tel. (305) 896-4881

### GEORGIA
**Decatur**
BCS Associates, Inc.
2522 Tanglewood Road
Zip: 30033
Tel: (404) 321-0980

### HAWAII
**Honolulu**
Industrial Electronics, Inc.
P.O. Box 135
646 Queen Street
Zip: 96817
Tel. (808) 533-6095

### ILLINOIS
**Chicago**
Cozzens & Cudahy Sales Group
John Fluke Mfg. Co., Inc.
1301 North Rand Road
Des Plaines, IL 60016
Tel. (312) 298-3600

### INDIANA
**Indianapolis**
Cozzens & Cudahy Sales Group
John Fluke Mfg. Co., Inc.
Port O'Call Executive Center
21 Beachway Drive
Zip: 46224
Tel. (317) 244-2456

### KANSAS
**Kansas City, MO**
Cozzens & Cudahy Sales Group
John Fluke Mfg. Co., Inc.
4406 Chouteau Traffic Way
Zip: 64117
Tel. (816) 454-5836

### KENTUCKY
**Louisville**
BCS Associates, Inc.
4506 Freda Way
Valley Station, KY 40272
Tel. (502) 935-9634

### MARYLAND
**Baltimore**
John Fluke Mfg. Co., Inc.
11501 Huff Court
Kensington, MD 20795
Tel. (301) 881-3370

### MASSACHUSETTS
**Boston**
Instrument Representatives
Sales Group
John Fluke Mfg. Co., Inc.
109 Massachusetts Ave.
Lexington, MA 02173
Tel. (617) 861-8620

### MICHIGAN
**Detroit**
WKM Associates, Inc.
345 Girard
Madison Heights, MI 48071
Tel. (313) 588-2300

### MINNESOTA
**Minneapolis**
Cozzens & Cudahy
Sales Group
John Fluke Mfg. Co., Inc.
10800 Lyndale Ave. S.
Zip: 55420
Tel. (612) 884-4336

### MISSOURI
**Kansas City**
Cozzens & Cudahy
Sales Group
John Fluke Mfg. Co., Inc.
4406 Chouteau Traffic Way
Zip: 64117
Tel. (816) 454-5836

**St. Louis**
Cozzens & Cudahy
Sales Group
John Fluke Mfg. Co., Inc.
P.O. Box 10013
Zip: 63145
Tel. (314) 423-1234

### NEW JERSEY
**Newark**
SBM Representatives
Sales Group
John Fluke Mfg. Co., Inc.
1519A Stuyvesant Ave
Union, NJ 07083
Tel (201) 687-8737

### NEW MEXICO
**Albuquerque**
Barnhill Associates, Inc
1410-D Wyoming N.E.
Zip: 87112
Tel. (505) 299-7658

### NEW YORK
**New York**
SBM Representatives
Sales Group
John Fluke Mfg. Co., Inc.
28 Hobby Street
Pleasantville, NY 10570
Tel. (914) 769-1811

**Rochester**
SBM Representatives
Sales Group
John Fluke Mfg. Co., Inc
4515 Culver Road
Zip: 14622
Tel. (716) 266-1400

### NORTH CAROLINA
**Greensboro**
BCS Associates, Inc.
P.O. Box 9619
1310 Beaman Place
Zip: 27408
Tel. (919) 273-1918

### OHIO
**Cleveland**
WKM Associates, Inc.
16141 Puritas Ave.
Zip: 44135
Tel. (216) 267-0445

**Dayton**
WKM Associates, Inc.
7913 S. Suburban Road
Zip: 45459
Tel. (513) 434-7500

### OREGON
**Beaverton**
Showalter Instruments Inc.
3800 S.W. Cedar Hills Blvd.
Suite 160
Zip: 97005
Tel. (503) 646-5196

### PENNSYLVANIA
**Philadelphia**
John Fluke Mfg. Co., Inc.
Suite H
1010 West 8th Avenue
King of Prussia, PA 19406
Tel. (215) 265-4040

**Pittsburgh**
WKM Associates, Inc.
90 Clairton Blvd.
Zip: 15236
Tel. (412) 892-2953

### TEXAS
**Austin**
Barnhill Associates, Inc.
1200 Barton Hill, No. 197
Zip: 78704
Tel. (512) 444-2377

**Dallas**
Barnhill Associates, Inc.
908 Business Parkway
Richardson, TX 75080
Tel. (214) 231-2573

**Houston**
Barnhill Associates, Inc.
10606 Hempstead Highway
Suite 132
Zip: 77092
Tel. (713) 688-9971

### VIRGINIA
**Williamsburg**
BCS Associates, Inc.
107 Rich Neck Road
Zip: 23185
Tel. (804) 877-4053

### WASHINGTON
**Benton City**
Showalter Instruments, Inc.
P.O. Box 828
Zip: 99320
Tel. (509) 588-3472

**Seattle**
Showalter Instruments, Inc.
1521 - 130th N.E.
Bellevue, WA 98005
Tel. (206) 455-4922

### WASHINGTON, D.C.
**Baltimore**
John Fluke Mfg. Co., Inc.
11501 Huff Court
Kensington, MD 20795
Tel. (301) 881-3370

For U.S. areas not listed, contact the regional office nearest you or John Fluke Mfg. Co., Inc., Mountlake Terrace, WA.

## Canada

### ALBERTA
**Calgary**
Allan Crawford Assoc., Ltd.
3829 - 12th Street N.E.
Zip: T2E 6M5
Tel. (403) 276-9658

### BRITISH COLUMBIA
**North Vancouver**
Allan Crawford Assoc., Ltd.
116 E. Third St., Suite 203
Zip: V7L 1E6
Tel. (604) 980-4831

### NOVA SCOTIA
**Halifax**
Allan Crawford Assoc., Ltd.
Suite 201, Townsend Pl.
800 Windmill Rd.
Burnside Industrial Park
Dartmouth, NS
Zip: B3B 1L1
Tel. (902) 469-7865

### ONTARIO
**Toronto**
Allan Crawford Assoc., Ltd.
6427 Northam Drive
Mississauga, Ont L4V 1J5
Tel. (416) 678-1500

**Ottawa**
Allan Crawford Assoc., Ltd.
1299 Richmond Road
Zip: K2B 7Y4
Tel. (613) 829-9651

### QUEBEC
**Montreal**
Allan Crawford Assoc., Ltd.
1330 Marie Victorian Blvd. E.
Longueuil, P.Q. J4G 1A2
Tel. (514) 670-1212

For Canadian areas not listed, contact the regional office nearest you or Allan Crawford Assoc., Ltd., Mississauga, Ontario.

All of the above Fluke Sales Offices carry local stocks of low-cost Digital Multimeters (Models 8000A, 8030A, 8040A), Counters (Model 1900A), Digital Thermometers (Models 2160A, 2170A, 2165A, 2175A) and the Universal Temperature Probe (Model 80T-150). These same products are available from the following distributors:

**Brownell Electronics**
Atlanta, GA (404) 762-5181
Charlotte, NC (704) 394-4341
Memphis, TN (901) 323-8554
Nashville, TN (615) 889-8230
Orlando, FL (305) 843-6770
Mobile, AL (205) 479-5405

**The Mancib Company**
Boston, MA (617) 272-9450
Middletown, CT (203) 346-6646

**Elmar Electronics**
San Francisco, CA (415) 961-3611
Denver, CO (303) 287-9611

**Pioneer-Standard**
Cleveland, OH (216) 587-3600
Dayton, OH (513) 236-9900
Indianapolis, IN (317) 849-7300
Pittsburgh, PA (412) 782-2300
Detroit, MI (313) 525-1800

**Liberty Electronics**
El Segundo, CA (213) 322-8100
San Diego, CA (714) 565-9171
Phoenix, AZ (602) 257-1272
Seattle, WA (206) 763-8200
Albuquerque, NM (505) 299-8293
Beaverton, OR (503) 644-4783

## Table 7-6. SALES REPRESENTATIVES – INTERNATIONAL

Supplied and supported by Fluke (Nederland) B.V.,
P.O. Box 5053, Zevenheuvelenweg 53, Tilburg, Netherlands.

**AUSTRIA**
Kontron GmbH & Co. KG
Ameisgasse 43
1140 **Vienna,** Austria
Tel: 222-945646

**BELGIUM**
C.N. Rood S/A
37 Place de Jamblinne de Meux
B-1040 **Brussels,** Belgium
Tel: 02-27352135

**CYPRUS**
Chris Radiovision Ltd.
P.O. Box 1989
**Nicosia,** Cyprus
Tel: 66121

**DENMARK**
Tage Olsen A/S
Teglvaerksgade 37
DK-2100 **Copenhagen Ø**, Denmark
Tel: 01-294800

**FINLAND**
Oy Findip AB
Teollisuustie 7
02700 **Kauniainen,** Finland
Tel: 080-502255

**FRANCE**
M.B. Electronique S.A.
Rue Fourney
ZAC de BUC
B.P. N° 31
78530 BUC, France
Tel: 9563130

**GERMAN FEDERAL REPUBLIC**
Fluke (Deutschland) GmbH
4-**Dusseldorf**
Meineckestrasse 53
West Germany
Tel: 211-450831

Fluke (Deutschland) GmbH
8000 **Munich** 80
Mutschellestrasse 1
West Germany
Tel: 089-433021

**GREECE**
Hellenic Scientific
Representations Ltd.
10, Nympheou Street
**Athens** 615, Greece
Tel: 021-7792320/705960

**ISRAEL**
R.D.T. Electronics
Engineering Ltd.
46, Sokolov Street
**Ramat Hasharon** 47235, Israel
Tel: 483211

**ITALY**
Sistrel S.p.A.
Via Giuseppe Armellini No. 37
00143 **Rome,** Italy
Tel: 5915551

Sistrel S.p.A.
Via Timavo 66
20099 Sesto S. Giovanni (**Milan**)
Italy
Tel: 02-2485233

**NETHERLANDS**
C.N. Rood, B.V.
Cort van der Lindenstraat 11-13
**Rijswijk** (Z.H.) 2100
Netherlands
Tel: 070-996360

Fluke (Nederland) B.V.
P.O. Box 5053
Zevenheuvelenweg 53
**Tilburg,** Netherlands
Tel: (13) 673973

**NORWAY**
Morgenstierne & Co. A/S
Konghellegate 3
P.O. Box 6688, Rodelökka
**Oslo** 5, Norway
Tel: 02-356110

**PORTUGAL**
Equipamentos
De Laboratorio Ltda.
P.O. Box 1100
**Lisbon** 1, Portugal
Tel: 019-976551

**SPAIN**
Ataio Ingenieros S.A.
Enrique Larreta 10-12
**Madrid** 16, Spain
Tel: 01-7330562

**SWEDEN**
Teleinstrument AB
P.O. Box 490
S-162 **Vallingby-4**
Sweden
Tel: 08-380370

**TURKEY**
M. Süheyl Erkman
Necatibey Cad 92/2
Karaköy/**Istanbul**
Turkey
Tel: 441546, 447651

**UNITED KINGDOM**
Fluke International Corp.
Garnet Close
**Watford,** WD2 4TT, England
Tel: 0923-33066

Customers in the following countries:

Bulgaria, Czechoslovakia, Hungary, Poland, Romania, U.S.S.R. and Yugoslavia

Contact: Amtest Associates Ltd., P.O. Box 55, Addlestone, Surrey, KT 15 1DU, England. Tel: 0932-52121.

Supplied and supported by Fluke International Corporation,
P.O. Box 43210, Mountlake Terrace, WA 98043.

**ARGENTINA**
Coasin S.A.
Virrey del Pino 4071
**Buenos Aires,** Argentina
Tel: 523185

**AUSTRALIA**
Elmeasco Instruments Pty Ltd
P.O. Box 30
**Concord,** N.S.W.
Australia 2137
Tel: (02) 736-2888

Elmeasco Instruments Pty Ltd.
P.O. Box 107
**Mt. Waverly,** VIC. 3149
Australia
Tel: 233-4044

**BOLIVIA**
Coasin Bolivia S.R.L.
Casilla 7295
**La Paz,** Bolivia
Tel: 40962

**BRAZIL**
Ambriex S.A.
Rua Ceara, 104-2°. e 3°. Andares
ZC-29
**Rio de Janeiro GB,** Brazil
Tel: 264-7406

Ambriex S.A.
Rua Tupi, 535
01233
**São Paulo SP,** Brazil
Tel: 66-0912, 66-5947

**CARIBBEAN & CENTRAL AMERICA**
West Indies Sales Co.
7360 Northwest 66th Street
**Miami,** FL 33166
Tel: (305) 592-8188

**CHILE**
Coasin Chile Ltd.
Casilla 14588—Correo 15
**Santiago,** Chile
Tel: 396713

**CHINA, PEOPLE'S REPUBLIC OF**
May Lee Industries, Ca, Inc.
11 Broadway, Suite 1612
**New York,** New York 10004
Tel: (212) 425-4347

**COLOMBIA**
Assistec Limitada
Apartado Aereo 12322
**Bogotá 1,** Colombia
Tel: 419331

**ECUADOR**
Proteco Coasin CIA, Ltda.
Apartado 228A
**Quito,** Ecuador
Tel: 526759

**EGYPT**
Lotus Engineering Organisation
P.O. Box 1252
**Cairo,** Egypt
Tel: 71617

**HONG KONG**
Gilman & Co., Ltd.
P.O. Box 56
**Hong Kong**
Tel: 794266

**INDIA**
Hinditron Services Pvt. Ltd.
69/A L. Jagmohandas Marg
**Bombay** 400 006, India
Tel: 365344, 381615

Hinditron Services Pvt. Ltd./
Hinditron Computers Pvt. Ltd.
"Hinditron House"
412 Rajmahal Vilas Extension
**Bangalore** 560 006, India
Tel: 32852

**INDONESIA**
P.T. United Dico-Citas Co., Ltd.
JLN Penjaringan 39A
**Jakarta,** Indonesia
Tel: 21380

**IRAN**
Berkeh Company Ltd.
20 Salm Road, Roosevelt Avenue
**Tehran,** Iran
Tel: 828294, 831564

**JAPAN**
Toyo Trading Company Ltd.
P.O. Box 5014
Tokyo International
**Tokyo** 100-31, Japan
Tel: (03) 279-0771

Toyo Trading Company, Ltd.
Suzuki Building
2-38 Junkeicho-dori
Minami-ku, **Osaka,** Japan
Tel: (06) 262-3471

**JORDAN**
Trading & Agricultural
Development Co.
P.O. Box 567
**Amman,** Jordan
Tel: 23052

**KENYA**
Advanced Communications Ltd.
City House, Wabera Street
P.O. Box 30635
**Nairobi,** Kenya
Tel: 31955

**KOREA**
Asia Science & Co.
International P.O. Box 1250
**Seoul,** Korea
Tel: 76-2761

**KUWAIT**
Tareq Company
P.O. Box Safat 20506
**Kuwait,** Arabian Gulf
Tel: 436100, 436045

**LEBANON**
General Marketing Trading &
Contracting Company
Anis Nsouli Street
Nsouli Building
P.O. Box 155.655
**Beirut,** Lebanon
Tel: 319383, 312061

**MALAYSIA**
O'Connor's (Pte) Ltd.
P.O. Box 1197
Kota Kinabalu, **Sabah**
East Malaysia
Tel: 54082

O'Connor's (Pte) Ltd.
P.O. Box 91
Petaling Jaya, **Selangor**
West Malaysia
Tel: 51563

**MEXICO**
Mexitek, S.A.
Eugenia 408
Department 1
**Mexico** 12, D.F., Mexico
Tel: 5360910

**MOROCCO**
S.I.E.E.M.
Residence Moulay Ismail
Bat. C.
Boulevard Moulay Slimane
**Rabat,** Morocco
Tel: 276-64

**NEW ZEALAND**
Elmeasco Instruments Pty. Ltd.
P.O. Box 4069
**Wellington,** New Zealand
Tel: 721318

**NIGERIA**
Mofat Engineering Co., Ltd.
P.O. Box 6369
**Lagos,** Nigeria

**PAKISTAN**
Pak International Operations
505 Muhammadi House-
McLeod Road
P.O. Box 5323
**Karachi,** Pakistan

**PERU**
Importaciones
y Representaciones
Electronicas S.A.
Avda, Franklin D. Roosevelt 105
**Lima** 1, Peru
Tel: 288650

**SAUDI ARABIA**
Electronic Equipment
Marketing Establishment
P.O. Box 3750
**Riyadh,** Saudi Arabia
Tel: 32700

**SINGAPORE**
O'Connor's (Pte) Ltd.
98 Pasir Panjang Road
**Singapore** 5, Singapore
Tel: 637944

**SOUTH AFRICA**
Fluke (Pty.) Ltd.
P.O. Box 13091
**Benoni** 1511, Transvaal
Republic of South Africa
Tel: 011-849-6811

Fluke (Pty.) Ltd.
24 Fountain Shopping Ctr.
Main Road
Rondebosche 7700
**Cape Town**
Republic of South Africa
Tel: 651881

**TAIWAN**
Tatung Company
22 Chungshan North Road
3rd Sec.
**Taipei,** Taiwan
Rep. of China
Tel: 5215252

**THAILAND**
Dynamic Supply
Engineering R.O.P.
No. 56 Ekamai, Sukhumvit 63
**Bankok**-11, Thailand
Tel: 914434, 928532

**URUGUAY**
Coasin Uruguaya S.R.L.
Cerrito 617-4° Piso
**Montevideo,** Uruguay
Tel: 917978

**VENEZUELA**
Coasin C.A.
APDO Postal 50939
Sabana Grande No. 1
**Caracas** 105, Venezuela
Tel: 722311

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MA21289

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